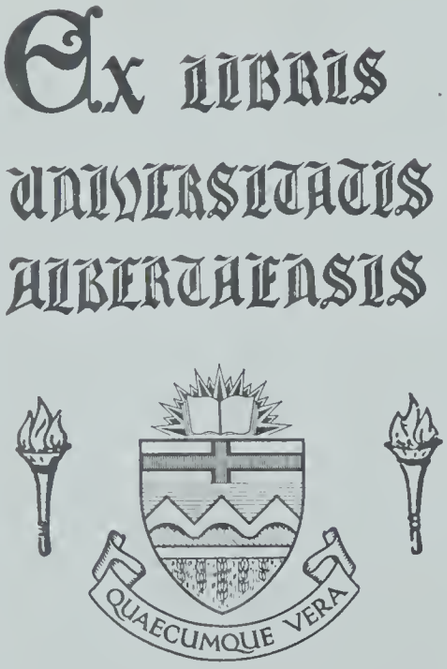

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PREDICTION OF ACADEMIC PERFORMANCE IN THE FACULTY OF PHYSICAL EDUCATION UNIVERSITY OF ALBERTA

by

RICHARD WAYNE LALOR

A THESIS

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled Prediction of Academic Performance in the Faculty of Physical Education University of Alberta submitted by Richard Wayne Lalor in partial fulfillment of the requirements for the degree of Master of Arts.

ABSTRACT

It was the purpose of this two-part study to examine certain aspects of academic prediction in the Faculty of Physical Education, UA. Problems examined in part one of the study were the feasibility of developing regression equations to predict certain measures of first-year academic performance, and the extent to which performance on the defined variables predicted the eventual conferring of a BPE degree. Resolution of the first problem entailed examination of: (a) the effects of treating men's and women's scores separately and collectively; (b) the predictive efficiency of grade XII first-writing scores compared to that of matriculation scores; and (c) the effectiveness of longitudinal prediction. The second part of the study consisted of an analysis of the utilization of applicable principles of academic prediction, developed in part one, on a single current BPE 1 class.

Academic performance of 159 BPE students (54 females, 105 males) over an eight-year period, 1956-57 to 1963-64, was selected as the basis of part one of the study. The current study group, registered for the 1968-69 term, consisted of 65 students (25 females, 40 males). Criteria were defined from academic courses requisite in the BPE 1 program and the actual receipt of a BPE degree. Predictors were developed from grade XII first-writing and matriculation scores, and from standardized test scores.

From the results of the study, the following conclusions were drawn:

1. Females' scores on the criteria were larger, less variable, and more predictable than males' scores. Variables predicted differently for females than males and, therefore, the use of combined study groups in future similar investigations would be unwarranted.

2. Grade XII first-writing scores were more efficient predictors of BPE 1 performance than corresponding matriculation scores for most variables and, therefore, should be considered in admissions and counselling procedures.

3. There was no significant decrease of predictive efficiency shown through the use of longitudinal predictions. Predictions could be made with sufficient accuracy for general counselling, but not for individual selection.

4. The criterion of receiving a BPE degree could be predicted with about the same accuracy as first year marks or average. BPE 1 variables, as a group, were the most efficient predictors of this criterion, although there were more efficient single predictors for the female subgroup. Communicative-linguistic variables predicted the criterion positively for females but negatively for males.

5. Most of the conclusions drawn relative to the initial study group were applicable to the current study group although there were apparent changes in the meanings of scores for certain variables. For regression equations to retain validity, therefore, they would have to be updated annually.

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TABLE OF CONTENTS

CHAPTER PAGE

LIST OF TABLES

TABLE PAGE

TABLE PAGE

TABLE PAGE

CHAPTER I

INTRODUCTION

A university becomes involved automatically in the processes of academic prediction when it establishes criteria for admission. It has a responsibility, then, to analyze these criteria frequently and critically to determine if desired predictive efficiency is being achieved.

The criteria for admission to university in Canada have been examined by several investigators to determine the validity of these criteria as predictors of subsequent academic performance. Techniques of differential prediction have been used in recent studies to develop multiple correlation coefficients from batteries of selected predictor variables. These multiple correlation coefficients have been consistently larger, particularly for certain subgroups of the university population, than corresponding zero-order correlation coefficients (5,25,35). Would additional improvements in predictive efficiency be possible if the variables and subgroups used for prediction were defined more restrictively than in previous studies?

The present study was undertaken to examine specific aspects of differential academic prediction as these might apply to guidance procedures for registration in the Faculty of Physical Education, University of Alberta.

Previous Alberta academic prediction studies have been based on the performances of students registered in a single academic term in faculties with numerically large annual enrollments. Performances of students in other faculties were grouped to obtain larger samples or were omitted entirely. In the present study, an enlarged sample was gained by pooling the achievement scores from students in sequent years.

Statement of the Problem

The present study had three basic purposes. The first was to examine the feasibility of developing regression equations for the prediction of first-year academic performance in the Faculty of Physical Education. Model regression equations would be computed, contingent upon the resolution of three subsidiary problems, namely: (a) analysis of the effects of treating men's and women's scores separately and collectively in all computations; (b) determination if predictive efficiency could be improved by using grade XII first-writing* scores as predictor variables rather than the more commonly used grade XII matriculation scores; and (c) analysis of the effectiveness of longitudinal prediction as developed in this study.

The second purpose of the study was to determine the extent to which performance on the defined grade XII and first-year university variables was predictive of the eventual awarding of a Bachelor of Physical Education degree.

The third purpose was to examine current application of the principles employed in the development of the model regression equations in light of recent changes in grade XII matriculation requirements, first-year Physical Education course requirements, and University of Alberta marking procedures.

Definition of Terms Used

UA. The University of Alberta, Edmonton.

BPE Program. The program leading to the degree Bachelor of Physical Education as offered by the School of Physical Education, UA,

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*See definitions.

for the period of the study. (On April 1, 1964, the school officially became the Faculty of Physical Education.)

BPE 1. The first year of the BPE program.

Grade XII Examinations. Grade twelve departmental examinations of the Alberta High School and University Matriculation and Examinations Board used as admissions criteria at UA.

First-writing Score. Score awarded on the initial attempt to gain matriculation credit in each grade XII course.

Matriculation Scores. Scores awarded on those grade XII examinations which gave qualification for matriculation to UA whether achieved at first-writing or on a subsequent attempt.

Longitudinal Prediction. An estimation of the probable level of a student's academic performance based on computations from students' scores from sequent years of classes.

Differential Prediction. Longitudinal prediction of academic performance in a specific course or program.

Guidance. The advising of prospective students relative to prediction of outcomes. The term counselling is used synonymously throughout. Decisions as to course of action are made by the individual in question rather than the counsellor.

Discussion of the Problem

Several investigations have been undertaken to examine various aspects of differential academic prediction for university freshmen. From a review of 272 selected studies, Travers (50) concluded that prediction of academic success in specific subject matter fields could be made with greater accuracy than overall predictions. Handy (30) based the development of a predictive index for the selection of physical

education teachers on a similar conclusion. Canadian investigators, Jackson and Fleming (34) in Ontario and Black (5) in Alberta, reported findings consistent with the conclusions reached by Travers and Handy.

The above-named investigators, and several others, have recommended the development of differential prediction formulae to improve academic prediction procedures and, thereby, indirectly improve university admission procedures. These recommendations were based on evidence summarized by Jackson (33:31) that:

> . . . no single formula can be applied with unvarying success to all departments, faculties, or even all universities. The aptitudes, skills, and personality characteristics that make for success in one field may be woefully inadequate in another. More studies are needed to identify and assess these characteristics and the pattern that makes for success in each of several recognizable fields.

Brown and Dubois (11) have indicated a shift in emphasis in prediction studies from investigations which covered the entire range of student abilities and curricula concurrently to studies which utilized more homogeneous groups of students. Prediction within a single faculty should result in homogeneous subgrouping and should, perhaps, improve prediction. Several Alberta investigators—Evenson and Smith (22), Black (3,5), Zurowsky (54), Mack (40), and Knowles (35)—reported superior prediction for individual faculty groups than for the total university population. The present study was undertaken to analyze various aspects of academic prediction in a single faculty—Physical Education at UA.

Black (5) and Zurowsky (54) have investigated the prediction of academic performance in individual courses at UA by analyzing the performances of all students enrolled in specified courses in a given term. In the present study, this concept of differential prediction was narrowed to the prediction of academic performances of BPE 1 students only in specified courses.

Transfer or withdrawal is an inefficient procedure from the standpoint of both the student involved and the university if program disruption is made necessary by an initial choice that was predictably inappropriate. To determine the extent to which performance on the defined variables of the present study have predicted one measure of undergraduate success (i.e. the conferring of a baccalaureate), biserial correlation coefficients were computed to compare performance on each variable with the eventual conferring of the degree Bachelor of Physical Education.

Analyses were performed separately for the male and female subgroups in the present study to retest the hypothesis that academic predictions can be made more accurately for women than for men. In earlier studies, Abelson (1) and Seashore (49) reported that female students were significantly more predictable academically than their male counterparts. Lewis (38), using a multiple prediction battery, reached a similar conclusion. Fleming (26) and Knowles (35) have confirmed the greater academic predictability of female students in Canadian universities. The hypothesis of superior academic predictability for female students was again challenged in the present study.

As students in Alberta are able to rewrite departmental examinations more than once, the problem of increased performance through repetition was also considered. Should a score achieved from a repetitive testing situation be treated in the same way as a similar score achieved in a single testing situation? The admissions procedure at UA treats such scores similarly, with the following exception (13:16):

> . . . any applicant who has had to write what the University considers to be an inordinate number of examinations because of failures and low marks, in order to attain the nominal entrance requirements of the University, may be refused admission on the ground that his chances for success at University level are remote.

Several investigators have examined aspects of the relationship between the number of years required to attain matriculation and subsequent university performance. In a departmental study (24) in the Faculty of Arts, UA, freshmen who had written between 10 and 25 entrance exams were compared with those who wrote less than 10 exams. Students who wrote less than 10 exams achieved a higher mean average than those exceeding 10 exams. Roberts and Ackroyd (48), in a study of Alberta students who matriculated in 1949, found that those requiring only three years to complete high school achieved a greater degree of success in their freshman year at UA than those requiring four or more years. Crompton's (17:40) results agreed completely with this. He concluded that:

> . . . students who complete University Entrance standing at first attempt perform at a higher level at university than students who are required to make more than one attempt . . ..

Fleming (26) reported that, in Ontario universities, the percentage of successful students declined from 86 among those who were 16 or younger at admission to 66 among those who were 20 or older when admitted. The latter group could be surmised to contain most of those students who required more than one attempt to attain matriculation.

On the basis of these findings, it could be hypothesized that repetitive examination scores did not predict in the same way as first-writing examination scores. Therefore in the present study, the hypothesis that mathematical prediction of university marks would be improved by the use of first-writing scores only for all predictor variables, was examined.

In keeping with the basic tenet of democracy—the principle of individual worth—the counselling function in this study was conceived to be one of informing and advising rather than one of selecting and

directing. In this context, an educational institution has the responsibility (19:1): " . . . to foster that development of individual capacities which will enable each human being to become the best person he is capable of becoming." The role of the counsellor then, was not to make decisions but to assist the counsellee in obtaining a better understanding of his aims and motives, his potentialities, and his probability of success in various goals, so that he could make more satisfying decisions.

Need for the Study

Several investigators reported findings to indicate problems of attrition and transfer in Canadian universities. Matthews (42:114) revealed statistics from registrars at Canadian universities that: " . . . indicated that about one-third of the high school students who come to university in Canada fail, for academic reasons, to graduate." Evenson and Smith (23) reported a withdrawal rate of 15 per cent by the end of the freshman year at UA. Jackson and Fleming (34) found, in a follow-up of the class entering the University of Toronto Arts Faculty in 1949, that 22.5 per cent withdrew without obtaining a degree and another 23.5 per cent transferred to another pattern.

In the School of Physical Education, UA, Crapo (16:13) found that the drop-out percentage increased consistently from 21.6 per cent of the 1959 class to 33.3 per cent of the 1962 class. He concluded that the latter percentage could become even greater because: " . . . those in the 1962 class have not even completed their second year as yet, and the drop-out rate is one-third of the total class entering in 1962." In the present study, 14 per cent of the total BPE 1 enrollment in the final two years transferred into Physical Education from other faculties.

From 1956-57 to 1963-64, 260 new students wrote BPE 1 final examin-

ations. Of these students, 100 (38 per cent) were successful in passing all examinations, 22 (9 per cent) were required to withdraw without credit, while the remaining 138 (53 per cent) received partial credit and were given permission for conditional continuation in the School.

In summary, the failure and drop-out rates in the School of Physical Education, UA, appeared to be at least as high as those in other faculties and in other universities. Increasing trends were indicated in drop-out and transfer rates in physical education. The clear-pass rate for students in BPE 1 was less than two in five.

If means were available which would enable students to avoid inappropriate choices at registration, it might be possible to avert a number of failures and transfers. Any decrease in the indicated attrition and transfer rates would result in more efficient utilization of student personnel. The present study was undertaken to examine the potential usefulness of longitudinal differential prediction as an instrument for counselling students on appropriate program selection.

Scope of the Study

The initial study group was delimited to students registered in eight sequent years of BPE 1 classes (1956-57 to 1963-64) who had recorded scores in each of the predictor and criterion variables ($N = 159$). This study group was composed of 105 male and 54 female students.

The selected eight-year period was the longest to date during which the defined predictor and criterion variables did not undergo any major changes of prerequisites, content, or emphasis, as defined by the appropriate course syllabi. Members of the 1956-57 class were the first to register in the three-year degree program in the School of Physical Education; members of the 1963-64 class were the last to register before

major revisions of this program were initiated in 1964-65. Because BPE 1 admission and program requirements were changed and a new grading system was instituted at UA, current application of the principles employed in the development of the initial model regression equations was examined by carrying out similar analyses of the academic performances of members of the 1968-69 class entering this faculty.

The regression equations were developed to indicate a means of guidance to students relative to program selection and change. To achieve this purpose, the choice of predictor variables was limited to those measures which would ordinarily be available to counsellors and faculty members prior to registration, or very shortly thereafter. Therefore, the predictor variables were derived from the grade XII matriculation courses and those standardized tests which were administered to all freshmen during the registration period.

First-writing scores, as well as matriculation scores where these differed, were recorded for the grade XII predictor variables to permit comparative analyses of the efficiency of prediction from the two sets of variables.

Limitations of Predictive Efficiency

Factors which limited predictive efficiency in other studies were considered to be operative in the present investigation as well. Several investigators have compiled detailed reviews of factors found to limit the precision of academic predictions. No attempt has been made in the present study to repeat the detail of these reviews. Instead, the limiting factors have been listed and sources indicated from which more comprehensive expositions are available.

The precision of academic predictions, then, has been delimited by:

1. the inability to isolate and define all appropriate contributing factors (2,51);

2. the existence of external, uncontrollable, unpredictable, and sometimes spontaneous factors which affect academic performance (2,37,54);

3. the range of talent in the study group (39);

4. the reliability and validity deficiencies of the predictor and criterion variables (7,39,40); and

5. inconsistent grading practices (6,32,52).

The present investigation was further delimited by the procedures and instruments used in its design. Three basic assumptions were made in defining the design of the present study. The efficacy of the derived regression equations will be limited to the extent that these assumptions were valid. These assumptions were:

1. that the defined study group was representative of the total BPE 1 registrants from 1956-57 to 1963-64;

2. that prediction was not affected by combining the scores for grade XII physics and biology into a single predictor variable (science); and

3. that prediction was not affected by the use of single criterion variables for English and psychology in the BPE 1 criterion variables. (Students could elect one of three options in English and one of two options in psychology. It was assumed that final scores in these two subject areas would not have differed significantly for the individual student, regardless of the option selected.)

An additional delimitation of the present study was inter-year variability of measures of the selected variables. Only the standardized test scores would seem to be unaffected by this variability as identical

test forms and standardized scoring procedures were used throughout.

Course content and scoring procedures could not be controlled as consistently for the grade XII predictors and the BPE 1 criteria. Changes were probable in the course content of these variables because of year to year differences in instructors, methods, and texts, even though the individual course syllabi were unchanged throughout. However, longitudinal prediction would be possible only if it was assumed that an individual student's score would not have differed significantly had he taken a course from a different instructor or during a different academic term.

Inter-year variability of evaluation practices at UA was investigated by Hocking (32) in 1958. He examined the variability of freshman marks over a 10-year period and found that the long-term averages differed significantly in size for 7 of the 11 courses investigated. Black (6,7) also tested the assumption of a consistent grading pattern in freshman grades. He made 1-year and 6-year retests of the validity of regression equations derived from the academic performances of members of the 1956-57 incoming class of engineers. Changes in evaluation criteria were reported for 3 of 8 variables the following year, and for an additional variable after 6 years. Based on these findings, it was assumed that inter-year variability of BPE 1 scores would limit the predictive efficiency of regression equations derived in the present study.

The Department of Education used scaling procedures to limit inter-year variability of scores from grade XII examinations, based on the following assumptions (47:61):

> Consistency in standards would require that the examinees be equally well prepared in the various subjects from year to year. In fact, the major assumption of the system is that the standards set by all the students in the province writing any one examination are more uniform from one year to the next than are the standards maintained in the minds of a small and changing group of examiners. It is

> thought that over a period of years the group of candidates sitting for examinations in a subject probably present the same level of attainment from year to year. (Emphasis in original.)

Black (7) examined the variability of grade XII scores after the 6-year interval and concluded that the assumption of consistent evaluation practices was valid. On this basis, it was not expected that the inter-year variability of grade XII scores would seriously limit the predictive efficiency of the findings of the present study.

Organization of the Thesis

The report of this study was set out in five chapters to detail, respectively, the nature of the problem, a survey of related literature, the procedure of the study, the findings of the study, and a summary and conclusion to the study.

CHAPTER II

RELATED LITERATURE

Past research on academic prediction was examined briefly in this review. The discussion of related literature was confined to prediction of academic performance in university programs in the following areas: (a) United States, (b) Canada (except UA), (c) University of Alberta, and (d) physical education.

Academic Prediction in United States Colleges

Fishman and Pasanella (25:298) have stated, relative to academic prediction in Colleges in the United States, that: "Admission to college and selection of applicants has probably become the most intensively explored topic in educational-psychological research." Though the sources were exhaustive, the findings of many of these studies had only limited significance for the current study. Therefore, the present discussion was limited to four reviews in which several hundred individual investigations were summarized.

Garrett (28), Travers (50), and Henry (31) summarized prediction studies completed prior to 1950. From these summaries, the following conclusions were drawn pertinent to the prediction of first-year college performance:

1. High school scholarship correlated more highly with college performance than did any other one factor.

2. General achievement tests, intelligence tests, and aptitude tests, respectively, ranked next in order as predictors of college achievement.

3. Prediction of academic success in specific subject matter fields

can be made with greater accuracy than overall predictions.

4. Women's scores correlated more highly with the criterion than did those of men.

5. Age at entrance correlated inversely with college performance, though youngness *per se* was not considered to be of importance. Those who were able to enter college at a young age could do so apparently because their superior mental ability permitted them to finish secondary school earlier.

6. The relationship of academic performance and other factors, such as motivation, personality measures, physical attributes, socio-economic position, and school size, was not demonstrated or was inconclusively shown.

7. Predictive efficiency was improved when the prognostic devices were used in combination. However, even the most effective of these combinations did not correlate highly enough to make individual prediction with any certainty for all cases.

Fishman and Pasanella (25) reviewed 580 academic prediction studies completed in the decade subsequent to 1950. Few changes from earlier studies were evident in the prediction of college academic performance on the basis of individual intellective predictors. Multiple correlation techniques were found to be utilized much more extensively. Gains in predictive efficiency were reported through the use of differential prediction.

Academic Prediction in Canadian Universities

Analyses of academic prediction at UA were summarized in a subsequent section of this report and, therefore, were excluded here.

Extensive academic prediction research has been carried out in

the province of Ontario. Much of this research was initiated by the Atkinson Study (33) on the utilization of student resources. Initially, this study was a straight-forward follow-up of the complete group of students enrolled in grade XIII in Ontario in the 1955-56 school year to study the supply of Canadian university talent. Conclusions of the Atkinson Study (26) were:

1. The grade XIII average was very definitely the best predictor of university success.

2. Aptitude test scores were much less effective as predictors than the grade XIII average and, for some courses, were practically useless as predictors.

3. Verbal aptitude test scores predicted better for the arts courses while the mathematical or quantitative scores predicted better for applied science, engineering, and medicine.

4. Sex was an important selective influence, giving boys a much better chance of entering grade XIII and continuing to university, but giving girls a superior achievement record in university.

5. Younger students were likely to be more successful at university than older ones, but age of entry, in itself, was likely a reflection of aptitude, achievement, and personality factors.

6. The higher the education level in the family, the greater the individual's chances of attending university or proceeding to other further education but, once admitted, there was little indication that chances of success were strongly related to the educational level of other members of the family.

7. Teachers' ratings would have been quite unreliable had they been used as university admissions criteria for the study group.

8. Many of the most promising students did not continue their

education in any form, exemplified by the fact that of the top quarter of the very highly selected grade XIII group, 40 to 45 per cent did not go to university.

In an earlier study, Fleming (27) completed a follow-up of a class entering Arts at the University of Toronto to examine the efficiency of predictors of academic performance at various levels in university. Using year-end averages for both predictor and criterion variables, he found correlation coefficients in the university pass course as follows: grade XIII mean with university first-year mean at 0.50; grade XIII mean with university third-year mean at 0.39; university first-year mean with university third-year mean at 0.60; and university second-year mean with university third-year mean at 0.65. The increasingly larger coefficients for undergraduate averages with university third-year average over the coefficients for grade XIII average with various university averages were not directly comparable because the sample was both decreasing in numbers and becoming more selected in membership each year.

Endler (20) summarized a number of studies at York University conducted as part of a research project entitled "Predictors of Academic Success." His conclusions were in agreement with those of the Atkinson Study, re-emphasizing that the best predictor of first-year university average was the high school average, female performances were significantly more predictable than those of males, and there were no consistent relationships found between personality variables and aptitude and achievement measures.

Payne, Davidson, and Sloan (46) reported the results of a predictive study at Queens University in which an elaborate battery of cognitive and personality tests were administered to 48 first-year undergraduate students in pre-law, pre-medical, and arts and science programs. In a three-

year follow-up, the investigators found that certain measures were not constant in their efficiency of prediction of various levels of undergraduate performance. High school matriculation average and a vocabullary measure (the Mill Hill Vocabulary Scale) correlated significantly with university first-year average (coefficients of 0.61 and 0.41 respectively) but neither correlated significantly with university third-year final average (coefficients of 0.02 and 0.15 respectively). Two cognitive measures, one of persistence (the Nufferno Individual Level Test) and one of speed under stress (the Nufferno Speed Test A2 Stressed), did not correlate significantly with university first-year performance (coefficients of 0.22 and 0.23 respectively) but were the only significant predictors of university third-year performance (coefficients of 0.47 and 0.32 respectively). A test to measure tendency to repress incompleted tasks given under stress (Alper's Standard Zeigarnik Experiment) was the only personality measure to correlate significantly with any of the criteria (coefficient of 0.37 with first-year average). The investigators concluded that academic prediction from the personality measures used in this study was strikingly unsuccessful. Some limitations may be placed on all of the findings of this study, however, because of an indication of selective bias in the formation of the study group as none of the 48 members had left the university after three years.

The Central Advisory Committee (45) of the Maritime provinces initiated a high school testing project to discover the percentage of able students that did not continue to university and to determine the best means of predicting university success. The study encompassed all high school students who graduated in 1961 in the provinces of Newfoundland, Nova Scotia, Prince Edward Island, and New Brunswick. High school marks and several standardized test scores were used as predictors. Mowat (44)

concluded that there was a serious loss of student potential as only about half of the pupils with ability to undertake higher education actually proceeded to do so. He found, as well, that the high school average proved to be much the best predictor of university success in the first year, being superior to marks in any single high school subject and to any of the standardized tests.

In an investigation reported by Conklin and Ogston (15), 639 new students at the University of Calgary during the 1966-67 term participated in an investigation to identify, where possible, any variables which might be related to freshman success. The students were divided into six groups with each group administered a test battery of somewhat different composition. Eight standardized tests, giving twenty measures in all including several which were non-intellective, and the final high school average were used to predict university first-year average. High school average correlated most highly with the criterion with a median coefficient of 0.49 for the six groups. The Co-operative Reading Tests had a median correlation coefficient of 0.41 and were the only measures to approach the predictive efficiency of the high school average. Multiple correlation coefficients for the six batteries ranged from 0.53 to 0.69, with a median of 0.62. The investigators concluded that the usefulness of psychological tests in the prediction of freshman success at the University of Calgary was limited. These measures had not correlated as highly as suggested in manuals, results fluctuated from group to group, and little was contributed to the multiple correlations beyond the amount already contributed by the high school average.

Academic Prediction at the University of Alberta.

Although there previously had been a number of isolated excursions

into the field of academic prediction at UA, a concerted effort in this direction was initiated in late 1954 with the formation of the Matriculation Study Subcommittee (22:64): " . . . to study the validity of the present system of selecting students for university education, and to explore the merits of alternative systems."

In the first of two major projects (21), the subcommittee examined the complete academic record of the freshman class of 1951 at UA to determine the predictive validity of existing measures. Coefficients of correlation with first-year UA average were as follows: grade XII average 0.48, grade IX average 0.40, ACE-T (American Council on Education Psychological Examination total) score 0.36, and grade IX general (Laycock Mental Ability) test 0.14. Coefficients were higher between first-year UA and Grade XII averages for individual faculty groups than for the overall group (engineering 0.59, arts and science 0.58, and education 0.54). However, precise comparison of correlation coefficients was impossible because the number of students with results in each predictor varied.

The second project (23) of the subcommittee was to determine if any of a number of selected measures might serve at UA as alternative admissions criteria. The CEEB (College Entrance Examination Board) achievement battery of seven tests was administered to members of the 1956 grade XII graduating class. Each student completed two tests of the battery. Correlation coefficients were computed for first-year average from CEEB and grade XII scores of those students who subsequently enrolled at UA for the 1956-57 term. Scores from each grade XII departmental examination correlated more highly with first-year UA average than did scores from the corresponding CEEB test (See Table I). More precise comparisons could not be made because comparison groups differed. Correlation coefficients for

TABLE I

CORRELATION COEFFICIENTS (r) BETWEEN
CEEB AND GRADE XII SCORES WITH
FIRST-YEAR UA AVERAGE
1956-57 #

Standardized Measures				Grade XII Departmentals	
Test	No.	r	r	No.	Test
CEEB Adv. Math.	298	.41	.56	316	Mathematics 31
CEEB Int. Math.	178	.34	.45	609	Mathematics 30
CEEB Physics	235	.38	.58	484	Physics 30
CEEB Chemistry	182	.38	.56	614	Chemistry 30
CEEB Biology	67	.26	.42	181	Biology 32
CEEB English	136	.20	.24	613	English 30
CEEB French	140	.29	.43	519	French 30

After Evenson and Smith (23:75-6).

Physics 30, Chemistry 30, and Mathematics 31 only were larger than 0.50. It was concluded that there was no evidence to indicate that the CEEB tests should replace grade XII finals for matriculation purposes.

The subcommittee also reported on the relationships between grade XII average, ACE scores, and freshman average with university performance at subsequent levels. Grade XII average correlated with university first-year average at 0.48 and university third-year average at 0.36. ACE correlation coefficients with the same criteria were 0.36 and .015 respectively. University first-year average correlated with university third-year average at 0.45. Correlation coefficients were not directly comparable, however, because the membership of all study groups varied.

In a departmental study reported by Clarke (14), Fair investigated the prediction of academic success at the first and third year levels in the Faculty of Arts and Sciences at UA. He studied the academic performance of 100 freshmen who registered in 1953 and continued in attendance through to 1956. Correlation coefficients with university first-year mean were 0.64 for the grade XII mean and 0.40 for the ACE tests. Coefficients with university third-year mean were 0.69 for university first-year mean, 0.40 for the grade XII mean, and 0.31 for the ACE tests.

Black (3) used the data of the 1956 study group for additional comparison of performance of selected predictors with UA 1956-57 freshman average. He used, as predictors, the tests of the CEEB battery, grade IX and XII departmental examinations, and a number of psychometric measures. The latter included SAT-V and SAT-M (Scholastic Aptitude Test - verbal and mathematical) scores, SCAT-V and SCAT-Q (School and College Ability Test - verbal and quantitative) scores, and ACE-L and ACE-Q (linguistic and quantitative) scores. The relative predictive efficiency of the psy-

chometric variables was indicated by the size of their median correlation coefficients with the criterion, as follows: SAT-M 0.348, SCAT-Q 0.301, ACE-L 0.294, SAT-L 0.275, SCAT-V 0.263, grade IX general 0.234, and ACE-Q 0.191. The grade XII and CEEB predictors produced larger correlation coefficients, but only the science XII mean coefficient (0.614) surpassed 0.500. Black concluded that the order of effectiveness of tests to predict first-year UA average was grade XII, CEEB, SAT, SCAT, ACE, and grade IX.

Black (4) then utilized a multiple correlation technique to examine the relationship of Grade IX departmental scores to UA freshman course results and final averages. The study group consisted of those students who had participated in the 1956 special grade XII testing program. Predictions were considered to be sufficiently accurate to be of value in guidance programs in the early high school years, but were inferior to those derived from grade XII departmental scores for UA guidance use.

In his third report to the Matriculation Study Subcommittee, Black (5) again applied multiple differential prediction techniques to predict performance in 30 freshman course areas at UA. The study sample again consisted of the 529 members of the 1956-57 UA freshman class who had participated in the 1956 special grade XII testing program. Multi-variable correlation coefficients were computed to determine the effects on predictive efficiency. The range of 5-variable correlation coefficients was 0.298 to 0.720, with median 0.653. Median increase in coefficient size of 0.032 was achieved by the development of a 16-variable coefficient. An additional median improvement of 0.032 was achieved when a 25-variable predictor combination was used. Black indicated that these

limited gains in predictive efficiency would be negated by the added complications of acquiring and calculating the larger multi-variable equations. Therefore, he concluded that the grade XII predictor variables were the best operational combination for the prediction of all UA course areas studied. Black (5:47) concluded, in addition, that:

> The findings of the study are unanimous in pointing out the differential nature of the Departmental examinations in predicting success in the University. The Grade XII Sciences are by far the major predictors of freshman success while other Departmental scores, notably English and foreign languages add little to indicate freshman success in the University. . . . The average which forms part of the present University admission practices assume that all subjects are of equal value in predicting freshman success. The evidence of this study denies this assumption.

Black (6) tested the validity of regression equations developed from the performance of the 1956-57 engineering sample by predicting the academic performance of 245 freshman engineers who entered UA in the fall of 1957. He subsequently compared estimated and actual correlation coefficients for predicted and received marks. Received marks compared favorably with predicted marks and the relationships between them did not drop nearly as much as had been anticipated. Black concluded that the regression equations tested dropped only slightly in validity when used to predict the performance of members of the succeeding year's class.

Black (7) subsequently retested the effectiveness of the 1956 regression equations by applying them to an entering class six years later. The equations were applied to a study group of 102 freshmen who registered in engineering in September, 1962. Performances in most of the criteria were predicted more accurately than in the 1957-58 retest, though the differences were not significant. It was concluded that the regression equations developed for the 1956 sample worked equally well for the 1962 sample and suggested unsuspected stability in grade XII and UA

evaluation procedures.

In his analysis, Black (7) computed seven-variable multiple correlation coefficients for the overall average and each of the seven courses required in freshman engineering at UA in 1962-63. Course coefficients ranged from 0.597 to 0.760, with median at 0.687. The coefficient for engineering average was 0.762.

Zurowsky (54) analyzed further the academic performance of the 529 members of the 1956 special study group. He investigated the differential predictive value of the grade IX departmentals, the grade XII departmentals, the SCAT tests, and the Cooperative English tests for nine selected science and business administration courses.

The grade XII science mean, computed from scores in Biology 32, Chemistry 30, and Physics 30, was found to be the best single predictor for nine of the ten criteria. A median correlation coefficient of 0.621 with the individual criterion variables and a coefficient of 0.632 with first-year average was attained.

Multiple correlation coefficients derived from the grade XII battery ranged from 0.526 to 0.720, with the median at 0.655. Similar coefficients from the entire battery ranged from 0.658 to 0.741, with a median of 0.709. Multiple correlation coefficients with the first-year average were 0.656 for the grade XII battery and 0.658 for the entire battery.

Numerical improvement of the best multiple correlation coefficients over that of the best single predictor ranged from -0.004 to 0.178, with a median of 0.050. Zurowsky concluded, therefore, that more efficient predictions could be made from multiple regression equations.

Mack (40) set out to develop expectancy tables of freshman performance at UA as a tool for student counselling. The study group consisted

of the entire first-year population in 1960-61, subdivided into five faculty groups. The initial step was to test the predictive efficiency of the available measures of pre-UA performance—the Coop-A test (Cooperative Expression Test - Form A), the Coop-C2 test (Cooperative Reading Comprehension Test - Form C2), the ACE tests, and the grade XII average. First-year average was selected as the criterion.

Correlation coefficients with the criterion for all predictors are shown on Table II. Grade XII average scores correlated most highly with the criterion on the basis of median coefficient size, followed in order by the Coop-A, Coop-C2, and ACE-T scores. Grade XII average scores were most effective in predicting performance of students in science, followed in order by the prediction of performance in engineering, arts, and education. The grade XII correlation coefficient for the other faculties group was unexpectedly large, surpassing all but the science group.

Knowles (35) undertook to determine the relative predictive values of two sets of high school evaluations, grade XII departmentals and principals' Easter ratings. The study group comprised 1,017 freshman students at UA in 1962 for whom appropriate information was available. Multiple correlation coefficients with first-year average were computed from a five-variable grade XII prediction battery. Data were categorized on the basis of size of graduating high school, sex of student, and faculty entered.

Principals' Easter rating scores were less effective than grade XII scores for predicting freshman performance at UA. Knowles concluded, however, that the ratings were adequately efficient to permit their possible use for such purposes as early provisional admission to UA.

The coefficient of multiple correlation between the prediction

TABLE II

CORRELATION COEFFICIENTS OF PREDICTOR VARIABLES WITH FIRST-YEAR AVERAGE OF TOTAL FACULTY GROUPS UA, 1960-61#

Predictor Variable	Faculty					Med. Coef.
	Arts	Sci.	Ed.	Eng.	Oth.	
Gd. XII Av.	.508	.715	.450	.549	.647	.549
Coop-A	.379	.384	.193	.151	.446	.379
Coop-C2	.321	.298	.219	.280	.390	.298
ACE-T	.260	.325	.174	.272	.354	.272
ACE-L	.253	.282	.195	.243	.389	.253
ACE-Q	.155	.297	.084	.234	.130	.155

After Mack (40:104-5).

battery and first-year average was 0.636 for the entire group. Coefficients were considerably larger for several of the defined subgroups of the study. Correlation coefficients for the various subgroups are shown on Table III. Knowles found that the differences in coefficient sizes between many of the subgroups were statistically significant. Thus, he concluded that:

1. Prediction for students from large high schools (more than 25 teachers) was significantly more accurate than for students from small high schools.

2. Prediction was most effective for engineering students, followed in order by those in science, arts, and education.

3. The grade XII prediction battery produced correlation coefficients numerically larger in every case than those obtained by Mack's use of the grade XII average.

4. Predictions for female students consistently could be made more accurately than for male students.

Black and Knowles (36) subsequently tested the effects of adding ACE scores to the grade XII prediction battery of 1962-63. No statistically significant increases were found in correlation coefficient size. It was concluded that the numerical gains in coefficient size were too small to warrant inclusion of ACE scores in the prediction battery unless such scores were normally and readily available as part of the student's record.

The distribution of grade XII scores of UA freshmen was invariably skewed because a minimal average was required for admission. Black and Knowles (36) tested the hypothesis that predictive efficiency would be improved if the prediction data were converted to normalized form.

TABLE III

MULTIPLE CORRELATION COEFFICIENTS BETWEEN
GRADE XII PREDICTION BATTERY AND UA FRESHMAN AVERAGE 1962-63
BY SEX, FACULTY, AND SIZE OF GRADUATING HIGH SCHOOL #

Faculty Entered	High School Size	Multiple Correlation Coefficients for Student Categories		
		Male	Female	Total
Arts	Small	.444	.693	.546
	Large	.733	.826	.783
	Total	.558	.746	.653
Education	Small	.495	.635	.586
	Large	.640	.651	.645
	Total	.470	.634	.596
Engineering	Small	.732	....	.732
	Large	.831	....	.831
	Total	.750	....	.750
Science	Small	.632	.621	.625
	Large	.799	.909	.818
	Total	.722	.796	.737
Total Group	Small	.555	.610	.560
	Large	.718	.791	.735
	Total	.635	.679	.636

After Knowles (35).

The findings tended to disprove the hypothesis, however. Only extremely modest differences were found between coefficients based on regular and normalized data. In fact, some validity coefficients from the normalized data were numerically but not significantly smaller than those previously obtained.

Academic Prediction in Physical Education

The academic performance of physical education students has been analyzed in several of the studies cited in the preceding section. Physical education students were not categorized as a distinct group in any of these studies, however. They have been considered as part of the entire freshman population or, in some instances, have been grouped with other students into an "other faculties" category.

The academic portion of the BPE 1 program at UA has continuously constituted the major portion of that program. However, research on the attributes of successful academic performance in physical education has been limited.

Crapo (16) touched on the problem of predicting academic success in the Faculty of Physical Education in his 1964 investigation. The purpose of the study was to determine the correlation between success in physical education and (a) grade XII average, (b) the number of grade XII departmentals written to attain that average, and (c) the number of years required to complete grade XII and attain matriculation standing. The study group comprised 150 students who were registered in BPE 1, UA, 1959 to 1962. The investigator concluded that individual relationships between the criterion and the predictors were not proven. He suggested that a combination of the predictors might be the best single means of predicting success in physical education. However, the validity of any

of these conclusions must be held suspect because of the absence of statistical treatment and supporting evidence in the report.

Handy (30) developed a predictive index as a basis for the selection of prospective physical education teachers in California. The coefficient of multiple determination for the prediction battery was 0.651. However, it is unlikely that the predictor variables utilized in his study could have any but cursory application for prediction to the physical education program at UA.

Implications for the Present Study

Analysis of the academic prediction research cited in the preceding sections of this chapter suggested a number of conclusions with implications pertinent to the present study:

1. Findings reported in Alberta studies were consistent with those of general academic research.

2. Grade XII course marks and average have been the best predictors of freshman academic performance at UA. Scores from certain Grade XII courses or combinations of courses were superior predictors to scores from other matriculation courses.

3. Multiple correlation coefficients from prediction batteries have been larger than zero-order correlation coefficients from individual or averaged predictors.

4. Prediction batteries from grade XII scores were most effective and generally had operational advantages. Other measures, less efficient predictors when used in isolation, may improve predictive efficiency when added to the grade XII prediction battery.

5. Prediction of individual courses was frequently superior to prediction of year average.

6. Prediction for specific faculty groups was usually superior to prediction for the overall student population.

7. Academic performance of female students was more predictable than that of male students.

8. Academic performance was more predictable for those who entered university at an age younger than the median for entering students.

9. Academic predictions were superior for students who attended large high schools than for those who attended small high schools.

10. University performance beyond first year was seldom predicted. However, in studies where this aspect was investigated, the most efficient predictors were found to be university first-year average, high school matriculation average, and standardized test scores, listed in descending order.

11. Academic performance in physical education has been the subject of limited investigation only.

CHAPTER III

PROCEDURE

A summary of the procedure used in this investigation is described below. The substance of the chapter was presented under three headings: (a) study group 1956-57 to 1963-64, (b) study group 1968-69, and (c) statistical design. Under each of the first two headings, the summary included descriptions of the criterion variables, predictor variables, and composition of the study group.

Study Group 1956-57 to 1963-64

Criterion Variables. The criteria of the study were the final scores in five BPE 1 courses, and the mean of these scores, for the UA academic terms 1956-57 to 1963-64. Over the final years of the study, these courses were designated (a) Chemistry 250, (b) English 200, 210, or 230, (c) Psychology 202, or 212, (d) Zoology 220, and (e) Physical Education 243. Changes were effected in the course numbering system during the first three years of the study, but no appreciable changes were indicated (13) in course content over the entire period. The numerical designation of the courses used as criteria is shown on Table IV. Also shown in Table IV is the classification of criterion variables used throughout the study.

Most members of the study group were registered in similar freshman course patterns. Alternate English and psychology courses could have been selected however, and a score presented in any such option was utilized as the criterion score.

The BPE 1 scores used as criteria in this study were those awarded following each student's initial attempt at an appropriate final ex-

TABLE IV

CRITERION VARIABLE CLASSIFICATION
FROM BPE 1 COURSES, UA,
1956-57 TO 1963-64 #

Criterion Variable Classification	Courses Used 1956-57 and 1957-58	Courses Used 1958-59	Courses Used 1959-60 To 1963-64
A. Chem	Chemistry 42	Chemistry 39	Chemistry 250
B. Eng	English 2 or English 5S or English 5E	English 2 or English 5S or English 5E	English 200 or English 210 or English 230
C. Psy	Psychology 40	Psychology 40 or Psychology 42	Psychology 202 or Psychology 212
D. Zoo	Zoology 1	Zoology 1	Zoology 220
E. Intro PE	Physical Education 103	Physical Education 103	Physical Education 243
F. BPE 1 Mn	Mean	Mean	Mean

Compiled from Calendars of the School of Physical Education, 1956 to 1963 (13).

amination. Consequently only regular term and deferred final scores were used.

Scores for Physical Education 243, a half course, were given only one-half the weighting of the other criterion variable scores in calculation of the BPE 1 mean.

Grade XII Predictor Variables. Predictor variable development was based on two considerations: (a) to include as many students as possible in the study group, and (b) to have a score for every student on every variable.

Eight predictor variables were developed from final scores of study group members in six grade XII courses taken in Alberta during or subsequent to the 1954-55 high school term. During that term, a revision of the Alberta senior high school curriculum was effected for grade XII courses. Constant definitions of course and credit prerequisites for admission to BPE 1 were retained for the study period (13). However, some grade XII course titles were changed in 1955-56.

Admission requirements into BPE 1 included the attainment of credit in three prescribed and three optional grade XII courses. The prescribed courses were English 30, Social Studies 30, and Chemistry 30. Final scores in these courses were used to develop three predictor variables.

The optional courses could be selected from Biology 32, Physics 30, Mathematics 30, and a foreign language (French 30, Latin 30, or German 30). Most BPE 1 registrants of the study period had credit in Mathematics and a foreign language but little preference was shown in selecting physics or biology as the third option. Mathematics scores were used to develop one predictor variable while foreign language scores were grouped to develop another. Scores in biology and physics were combined

to develop a single science predictor variable. These scores were further combined with chemistry scores to develop a science mean predictor variable.

The eighth predictor variable was the grade XII mean developed from each student's average score on all grade XII courses used in this study.

Grade XII predictor variable classification, and the courses used to derive these variables, is given in Table V. These predictor variables, numbered 1 to 8 and with the subscript 1 appended, are used subsequently to designate grade XII first-writing scores.

The grade XII matriculation scores presented by students for admission to UA were classified as variables numbered 14 to 21, each designated with the subscript M. Many matriculation scores were identical to the corresponding first-writing scores although 86 members of the study group (71 males and 15 females) had rewritten one or more grade XII examinations prior to registration in BPE 1.

Standardized Predictor Variables. Student Counselling Services, UA, supervised the group-administration of a number of standardized test forms to all incoming freshmen during registration week each September 1956 to 1963. These examinations were administered as an adjunct to registration, not as a prerequisite to it.

The Coop-C2 test was administered during all years of the study while the Coop-A and the ACE tests were administered during all years except 1958-59. Five standardized predictor variables, as shown in Table VI, were developed from scores on these measures.

Study Group. A total of 329 students were registered in BPE 1, UA

TABLE V

PREDICTOR VARIABLE CLASSIFICATION
FROM ALBERTA GRADE XII COURSES
1954-55 TO 1962-63#

Predictor Variable Classification		Course Title	Course Title
First-Writing	Matriculation	1954-55	1955-56 to 1962-63
1. Eng_1	14. Eng_M	English 30	English 30
2. So St_1	15. So St_M	Social Studies 30	Social Studies 30
3. $Chem_1$	16. $Chem_M$	Science 30	Chemistry 30
4. Sci_1	17. Sci_1	Science 31 or Science 32 or Mean of these two if both taken	Physics 30 or Biology 32 or Mean of these two if both taken
5. Sci Mn_1	18. Sci Mn_M	Mean of Science 30 and (Science 31 and/or Science 32)	Mean of Chemistry 30 and (Physics 30 and/or Biology 32)
6. $Math_1$	19. $Math_M$	Mathematics 30	Mathematics 30
7. For L_1	20. For L_M	French 30 or Latin 30 or German 30	French 30 or Latin 30 or German 30
8. Gd XII Mn_1	21. Gd XII Mn_M	Mean	Mean

Compiled from Senior High School Handbooks, Department of Education, Province of Alberta, 1954-55 to 1962-63.

TABLE VI

CLASSIFICATION, TITLES, AND ADMINISTRATION DATES OF STANDARDIZED-TEST PREDICTOR VARIABLES BPE 1, UA, 1956-57 TO 1963-64#

Predictor Variable Classification	Complete Test Title	UA Terms During Which Test Administered 1956-57 to 1963-64
9. Coop-C2	Cooperative Reading Comprehension Test - Form C2	All
10. Coop-A	Cooperative English Expression Test - Form A	All except 1958-59
11. ACE-Q	American Council on Education Psychological Examination for College Freshmen - Quantitative Tests	All except 1958-59
12. ACE-L	American Council on Education Psychological Examination for College Freshmen - Linguistic Tests	All except 1958-59
13. ACE-T	American Council on Education Psychological Examination for College Freshmen - Total or Gross Score	All except 1958-59

Compiled from instruction manuals of the Cooperative Test Division, Educational Testing Service, Princeton, N.J., and from records of Student Counselling Services, University of Alberta.

during the years 1956-57 to 1963-64. Of this total, 159 (48.3%) had complete records in all variables and were retained in the study group. The study group was composed of 105 male students and 54 female students. A year-by-year breakdown of the composition of the study and non-study groups is shown in Table VII.

Students were excluded from the study group if their academic records were incomplete. Most of the 56 students whose records were defined as incomplete were deficient in standardized test scores, including 16 members of the 1958-59 class who wrote a different set of standardized tests than the study group members. Also excluded with incomplete records were 7 students who withdrew from UA before completing BPE 1 and another 6 who were not assigned percentage scores for one or more criterion variables.

A further 53 students were removed on the basis of non-residence in Alberta while previous university attendance excluded 30 more. The latter had received advance credit in portions of the BPE 1 program.

Also excluded from the study group were 22 students who presented grade XII scores in both physics and biology but no score in either mathematics or a foreign language. Another 9 students were rejected because they acquired at least some of their grade XII credits previous to the 1954-55 high school term.

Study Group 1968-69

Criterion Variables. Curricular changes in the BPE 1 program made necessary two changes in definition of criterion variables for this aspect of the study. No longer requisites for BPE 1, Chemistry 250 was replaced with a science option and Zoology 220 with an option from either arts or science.

TABLE VII

COMPOSITION OF STUDY AND NON-STUDY GROUPS
BPE 1, UA, 1956-57 TO 1963-64

Category	Commencement of BPE 1 Year								Totals	%
	'56	'57	'58	'59	'60	'61	'62	'63		
Total registration BPE 1 #.	28	19	27	33	44	38	54	86	329	100
Students included in study	12	10	3	16	27	22	24	45	159	48.3
Students excluded from study. . . .	16	9	24	17	17	16	30	41	170	51.7
Reasons for Exclusion										
Incomplete record.	3	1	17	8	5	5	6	11	56	17.0
Non-Alberta grade XII	7	2	3	5	6	5	12	13	53	16.1
Advance credit for part BPE 1. . . .	0	3	1	0	3	3	10	10	30	9.1
No grade XII math or lang option. .	2	2	2	2	3	2	2	7	22	6.7
Some grade XII previous to 54-55	4	1	1	2	0	1	0	0	9	2.8

From records of the School of Physical Education, UA, 1956-57 to 1963-64.

Biology (either 130 or 230) was the chosen science elective for over eighty per cent of the study group, with mathematics options the next most frequent choice. Sociology 202 was the elected arts or science option for more than half of the study group members, with other frequent choices in history, philosophy, and genetics.

Scores for the science electives and the arts or science electives were grouped to form two separate variables classified, respectively, as follows: A. Sci Op, and D. A or S Op. The other four criterion variables—English, Psychology, Introductory Physical Education, and BPE 1 Mean—remained as previously defined.

Criterion scores were recorded on a nine-point scale rather than as percentages. In the calculation of the BPE 1 mean, Physical Education 243 (offered two-hours weekly for a half-year) was assigned one-third of the weighting factor of the other four criterion course variables.

Grade XII Predictor Variables. The development of predictor variables was again based on the considerations (a) to include as many students as possible in the study group, and (b) to have a score for every student on every variable. In addition, to provide bases for meaningful comparisons with the earlier study group, an attempt was made to retain as much similarity as possible to previous predictor variable definitions.

Admission requirements into BPE 1 had changed to include the attainment of at least a 60.0 per cent average in five grade XII matriculation courses rather than the previous six. Three of these courses—English 30, Chemistry 30, and Biology 30—were prescribed. Many entering students were deficient in the biology requirement however, and were required to select Biology 130 as their BPE 1 science option to rectify this deficiency. The two optional matriculation courses could be selected from (a)

Social Studies 30, (b) Physics 30, (c) Mathematics 30, (d) Mathematics 31, and (e) an approved language other than English.

Despite the changes effected in BPE 1 admission requirements, there was little change in the pattern of courses presented for admission except that foreign language options were used infrequently as matriculation subjects. Almost all students had credit in social studies and the majority of those who were deficient in biology had credit in physics. It was possible, therefore, to retain definitions of grade XII predictor variables similar to those used previously excepting for the mathematics and foreign language variables. Since some students had received credit in both mathematics courses, such scores were combined to develop a single mathematics variable. The foreign language predictor variable was deleted from this portion of the study to permit the retention of 22 students in the study group that were deficient in this area.

Standardized Predictor Variables. The standardized predictor variables were deleted from this portion of the study because a number of students were deficient in standardized test scores and different standardized measures were administered than those used for the earlier study group. Form A of the CAAT (Cooperative Academic Ability Test) was administered to the 1968-69 study group rather than the ACE and Coop Reading tests that were administered previously.

Study Group. The 1968-69 registration in BPE 1 at UA totalled 95 students, of which 65 (25 females and 40 males) were retained in the study group. The deletion of the foreign language and standardized predictor variables permitted the retention of 33 students who would have had incomplete records otherwise.

Of the 30 students rejected from the study group, 11 withdrew from all or parts of the BPE 1 program prior to completion, 10 attended high school outside Alberta, 5 had incomplete records in the defined grade XII predictor variables, and 4 received advance credit in portions of the BPE 1 program on the basis of previous university attendance.

Statistical Design

Variable scores and other pertinent information about each subject were coded and keypunched on computer cards. Initial computations for each of the three study groups (female, male, and total) were then completed for each set of data utilizing the UA computer I.B.M. 360/67 and the program "MULRØ4 - Regression Analysis" (53). Model cards were used to define pre-selected combinations of predictor variables from which to develop regression equations for each criterion variable. Also included in this program output would be calculations of means and standard deviations for all variables and multi-column intercorrelation matrices for each of the three groups.

Various comparisons and tests of significance were applied to different sets of derived data to resolve the subsidiary aspects of the initial problem of this study. Regression equations of greatest efficiency were then selected for each criterion and the standard error of estimate was computed for each.

All calculations for the male and female study sub-groups were made separately as well as in combination.

CHAPTER IV

FINDINGS

The findings of this study, exposited both in paragraph and tabular form, were presented in two main sections. First, results were presented of analyses of findings pertaining to the initial (1956-57 to 1963-64) study group. These included comparisons of female and male academic performance and predictions, comparison of predictions from first-writing and matriculation scores, longitudinal prediction, and predictability of the awarding of a baccalaureate in physical education. Second, results were presented of similar analyses (excepting the longitudinal and degree-awarding predictions) of findings pertaining to the current (1968-69) study group.

Study Group 1956-57 to 1963-64

Means and standard deviations of scores in all variables for the female and male subgroups and the total group are shown in Table VIII. Complete intercorrelation matrices for the female subgroup, male subgroup, and total group are shown in Appendix A in Tables XXVII, XXVIII, and XXIX, respectively.

Female-Male Academic Performance. There were many apparent differences in the performance level of members of the female and male subgroups on the variables of this study. Mean scores for the female subgroup characteristically were larger than those of the male subgroup, significantly so at the .05 confidence level for thirteen of the twenty-seven variables. Mean scores for the male subgroup were larger for only five variables and, in these cases, no difference was found to be statistically significant.

TABLE VIII

MEANS, STANDARD DEVIATIONS, ALL VARIABLES
1956-57 TO 1963-64

Variable	Female Subgroup N = 54 Mean	Std Dev	Male Subgroup N = 105 Mean	Std Dev	Total Group N = 159 Mean	Std Dev
A.Chem	52.44	17.33	56.88	16.19	55.37	16.72
B.Eng	58.78**	9.70	51.93**	8.57	54.26	9.54
C.Psy	60.28	7.69	58.50	8.30	59.10	8.14
D.Zoo	53.91	10.32	54.16	10.86	54.08	10.68
E.In PE	67.35**	10.05	62.79**	9.89	64.34	10.18
F.BPE 1 Mn	57.57	8.62	56.22	7.67	56.68	8.03
1.Eng_1	67.17**	10.17	56.81**	11.22	60.33	11.93
2.So St_1	64.98	10.95	61.87	10.08	62.92	10.49
3.$Chem_1$	61.54	10.76	58.69	12.97	59.65	12.34
4.Sci_1	69.91**	11.48	60.30**	11.01	63.56	12.06
5.Sci Mn_1	66.00**	9.08	59.71**	10.55	61.85	10.51
6.$Math_1$	59.13	10.90	56.37	14.28	57.31	13.29
7.For L_1	65.83**	13.06	53.83**	14.32	57.91	15.02
8.Gd XII Mn_1	64.81**	7.79	58.10**	8.60	60.38	8.92
9.Coop-C2	26.44	7.07	24.58	7.72	25.21	7.56
10.Coop-A	116.57**	14.22	102.55**	16.94	107.31	17.38
11.ACE-Q	43.93	9.00	45.77	7.15	45.14	7.88
12.ACE-L	67.17	8.72	64.50	9.81	65.41	9.54
13.ACE-T	111.09	14.42	110.28	14.26	110.55	14.32
14.Eng_M	67.81**	9.30	61.10**	8.04	63.38	9.07
15.So St_M	66.56	8.63	65.17	7.53	65.64	7.95
16.$Chem_M$	64.72	8.54	66.71	8.22	66.04	8.38
17.Sci_M	71.91**	9.75	64.96**	8.25	67.32	9.38
18.Sci Mn_M	68.17*	7.63	65.52*	6.73	66.42	7.16
19.$Math_M$	61.81	9.63	63.40	10.52	62.86	10.25
20.For L_M	66.69**	11.91	60.50**	11.85	62.60	12.22
21.Gd XII Mn_M	66.63**	5.99	63.72**	4.75	64.71	5.38

*Difference between means for female and male subgroups significant at .05 level.

** Difference between means for female and male subgroups significant at .01 level.

Means for the female subgroup were larger than those for the male subgroup for five of six criterion variables, significantly larger for the English and introductory physical education variables. The chemistry variable was the only criterion in which the mean for the male subgroup was larger than that for the female subgroup.

Grade XII means for the female subgroup were larger than the corresponding means for the male subgroup for all first-writing variables and six of eight matriculation variables. The chemistry and mathematics matriculation means for the males were larger, though not significantly so, than for the females. However, mean scores for the female subgroup were significantly superior to those of the male subgroup in both first-writing and matriculation scores for five grade XII predictor variables—English, science, science mean, foreign language, and grade XII mean.

Female subgroup mean scores for the standardized predictor variables were larger than those for the male sub-group for all cases except the ACE quantitative scores. Of the standardized measures used, however, only the Coop-A variable mean score for the female subgroup differed significantly from that of the male subgroup.

Female-Male Academic Prediction. Zero-order correlation coefficients between predictor variable scores and criterion variable scores characteristically were larger for the female subgroup than the male subgroup. In all, female subgroup scores correlated more highly with the criterion for 101 of 126 measures—80 per cent of the total. Eleven of these differences were significant at the .05 level of confidence. No differences favoring the male subgroup were found to be significant. Comparative zero-order correlation coefficients between all criterion and predictor variables for the female and male subgroups are shown in Table IX.

TABLE IX

COMPARATIVE ZERO-ORDER CORRELATION COEFFICIENTS
BETWEEN CRITERION VARIABLES AND ALL PREDICTORS
FOR FEMALE AND MALE SUBGROUPS
1956-57 TO 1963-64

Predictors		Criterion					
		A. Chem	B. Eng	C. Psy	D. Zoo	E. In PE	F. BPE Mn
1. Eng_1	r_F	.039	.400	.447	.217	.211	.293
	r_M	.068	.477	.383	.238	.338	.371
2. So St_1	r_F	.369	.591*	.546	.541	.656*	.658*
	r_M	.199	.243	.379	.297	.405	.397
3. $Chem_1$	r_F	.406	.397	.303	.367	.341	.487
	r_M	.425	.247	.234	.236	.273	.433
4. Sci_1	r_F	.288	.438	.366	.587	.347	.516
	r_M	.350	.188	.350	.355	.204	.431
5. Sci Mn_1	r_F	.420	.512	.406	.584	.418	.610
	r_M	.432	.241	.297	.324	.273	.481
6. $Math_1$	r_F	.420	.311	.101	.388	.099	.403
	r_M	.482	.180	.294	.179	.246	.440
7. For L_1	r_F	.383	.286	.480*	.387	.329	.483
	r_M	.388	.254	.177	.194	.216	.370
8. Gd XII_1	r_F	.455	.562	.531	.596*	.473	.674
	r_M	.471	.365	.409	.340	.392	.576
9. Coop C2	r_F	.186	.472	.529	.373	.379	.460
	r_M	-.112	.350	.315	.169	.165	.190
10. Coop A	r_F	.148	.272	.249	.402*	.251	.321
	r_M	.038	.324	.270	.065	.181	.204

* Difference between corresponding correlation coefficients for female and male subgroups significant at .05 level of confidence.

TABLE IX (CONTINUED)

Predictors		Criterion A. Chem	B. Eng	C. Psy	D. Zoo	E. In PE	F. BPE Mn
11. ACE-Q	r_F	.192	.219	.065	.206	.170	.234
	r_M	.053	.195	.022	.037	.075	.090
12. ACE-L	r_F	.170	.327	.471	.298	.364	.387
	r_M	-.009	.420	.407	.242	.230	.308
13. ACE-T	r_F	.222	.334	.325	.308	.326	.380
	r_M	.020	.386	.291	.185	.196	.257
14. Eng_M	r_F	.034	.334	.372	.156	.200	.241
	r_M	-.058	.406	.321	.127	.220	.221
15. $So\ St_M$	r_F	.365	.492	.441	.471	.614*	.584*
	r_M	.131	.227	.285	.251	.349	.310
16. $Chem_M$	r_F	.338	.170	.160	.343	.082	.333
	r_M	.299	.051	.009	.129	.039	.210
17. Sci_M	r_F	.229	.343	.222	.583	.221	.417
	r_M	.251	.155	.300	.331	.081	.345
18. $Sci\ Mn_M$	r_F	.294	.313	.254	.525	.205	.431
	r_M	.406	.167	.249	.313	.096	.407
19. $Math_M$	r_F	.450	.238	.122	.343*	.114	.398
	r_M	.361	.061	.171	.014	.115	.246
20. $For\ L_M$	r_F	.389	.275	.475*	.456	.362	.506
	r_M	.305	.172	.151	.197	.199	.295
21. $Gd\ XII_M$	r_F	.479	.482	.481	.637*	.425	.660
	r_M	.435	.321	.381	.328	.311	.518

Though all differences were not significant, consistent differences in coefficient size, favoring the female over the male subgroup, were apparent for five of the six criterion variables. Correlation coefficients of the female subgroup were consistently larger for the zoology and BPE 1 mean criteria, and only slightly less so for the psychology, introductory physical education, and English criteria. Correlation coefficients with the chemistry criterion were not consistently larger for either subgroup, and no difference between coefficients with this criterion was significant.

Similar differences in female-male predictability were apparent with the grade XII predictor variables. All of the intercorrelation coefficients with the social studies predictors and the six criteria were larger for the female subgroup than for the male subgroup, and five of these differences were significant at the .05 level of confidence. Though differences were less frequently significant, consistent patterns of larger correlation coefficients for the female subgroup were found also for the chemistry, science mean, foreign language, and grade XII mean predictors. Other variables did not predict consistently. Correlation coefficients with the criteria for the male subgroup were larger in most cases, though none significantly, for the first-writing predictors in English and Mathematics but not for the matriculation predictors of the same two courses.

Prediction from performance on the standardized test predictor variables also favored the female subgroup. Correlation coefficients with the criteria of the females' standardized test scores consistently were larger than those of the males, although only one such difference was significant.

In determining the most efficient single predictor for each criterion, a consistent pattern was again apparent favoring the hypothesis of greater academic predictability of females. The largest zero-order correlation coefficients were of approximately equal size for females and males for the chemistry criterion only (0.479 and 0.482 respectively). Coefficients for the other five criteria ranged from 0.546 for psychology to 0.674 for BPE 1 mean for the female subgroup, but only from 0.355 for zoology to 0.576 for BPE 1 mean for the male subgroup. A complete comparison of the largest zero-order correlation coefficients with each criterion and for each subgroup is shown in Table X.

Two other generalizations were apparent when the best single predictor variables of each criterion were compared. First, there appeared to be a strong relationship between the predictive efficiency of certain variables and the sex of the subgroup to which the prediction was directed and, second, certain variables appeared to predict to a broad range of criteria. For example, the first-writing social studies predictor variable was the most efficient single predictor for three of the six criteria for the female subgroup but for only one of the criteria for the male subgroup. Similarly, the grade XII matriculation mean was the most efficient predictor for two criteria for the female subgroup but was not the most efficient predictor for any of the criteria for the male subgroup. Whereas most efficient prediction of the criteria was attained from either a social studies or a grade XII mean predictor variable for the female subgroup, five different variables performed this function for the male subgroup. Only the grade XII mean predictor variable duplicated as the most efficient predictor of two criteria for the male subgroup.

TABLE X

LARGEST ZERO-ORDER CORRELATION COEFFICIENTS
FOR EACH CRITERION VARIABLE FOR
MALE, FEMALE, AND TOTAL GROUPS
1956-57 TO 1963-64

Criterion Variables	Female Subgroup N = 54		Male Subgroup N = 105		Total Group N = 159	
	r	Predictor*	r	Predictor*	r	Predictor*
A.Chem	.479	(Gd XII Mn_M)	.482	($Math_1$)	.440	($Math_1$)
B.Eng	.591	(So St_1)	.477	(Eng_1)	.524	(Eng_1)
C.Psy	.546	(So St_1)	.409	(Gd XII Mn_1)	.451	(Gd XII Mn_1)
D.Zoo	.637	(Gd XII Mn_M)	.355	(Sci_1)	.424	(Gd XII Mn_M)
E. In PE	.656	(So St_1)	.405	(So St_1)	.510	(So St_1)
F.BPE 1 Mn	.674	(Gd XII Mn_1)	.576	(Gd XII Mn_1)	.593	(Gd XII Mn_1)

* Subscript 1: Coefficient calculated from grade XII first-writing scores.
Subscript M: Coefficient calculated from grade XII matriculation scores.

Multiple correlation coefficients with each criterion were developed separately for the female and male subgroups from three combinations of predictors—six grade XII variables, four standardized variables, and a combination of these ten variables. For each criterion, the multiple correlation coefficient for the female subgroup was larger than the corresponding coefficient for the male subgroup for all three combinations of predictors. Coefficients for the female and male subgroups differed significantly at the .05 level of confidence for the zoology and introductory physical education criteria for both the six and ten variable combinations of predictors. No difference in coefficient size was significant for the four variable standardized test combination. All of the comparative multiple correlation coefficients for the three combinations of predictor variables are shown in Table XI.

Prediction From Grade XII First-Writing and Matriculation Scores. A complete comparative listing of grade XII first-writing and matriculation zero-order correlation coefficients for each criterion for the female subgroup, male subgroup, and total group is shown in Tables XII, XIII, and XIV respectively.

Zero-order correlation coefficients between first-writing predictor scores and criterion scores characteristically were larger than coefficients between matriculation predictor scores and the same criterion scores. This was particularly true for the male subgroup where only one of forty-eight matriculation coefficients was larger than the corresponding first-writing coefficients, and the difference between these two was not significant. Conversely, seven of the first-writing coefficients were significantly larger, at the .05 level, than the corresponding matriculation coefficients for the male subgroup.

TABLE XI

COMPARATIVE MULTIPLE CORRELATION COEFFICIENTS (R) OF THREE COMBINATIONS OF PREDICTOR VARIABLES WITH ALL CRITERION VARIABLES FOR FEMALE AND MALE SUBGROUPS 1956-57 TO 1963-64

Criterion Variables		Predictor Combinations: Grade XII[a] (6 Variables)	Standardized Tests (4 Variables)	Grade XII[a] and Standardized Tests (10 Variables)
A.Chem	R_F	.624	.238	.629
	R_M	.555	.167	.571
B.Eng	R_F	.639	.491	.660
	R_M	.502	.446	.541
C.Psych	R_F	.638	.605	.741
	R_M	.503	.459	.574
D.Zoo	R_F	.678*	.480	.729*
	R_M	.415	.256	.446
D.Zoo	R_F[a]	.691*	----	.770*
	R_M	.428	----	.465
E.Intro PE	R_F	.708*	.431	.722*
	R_M	.461	.245	.467
F.BPE 1 Mn	R_F	.754	.508	.779
	R_M	.586	.317	.607

[a]Grade XII first-writing predictor variables used except for second set of correlations with Zoology criterion in which the corresponding matriculation scores were used.

*Difference between corresponding correlation coefficients for female and male subgroups significiant at .05 level of confidence.

TABLE XII

COMPARATIVE CORRELATION COEFFICIENTS OF GRADE XII FIRST-WRITING (n_1) SCORES AND GRADE XII MATRICULATION ^{1}(n_M) SCORES WITH CRITERION SCORES
1956-57 TO 1963-64
FEMALE SUBGROUPS
N = 54

Predictors	Criteria (A) Chem	(B) Eng	(C) Psy	(D) Zoo	(E) In PE	(F) BPE 1
Eng_1 (1)	.039	.400	.447*	.217	.211	.293
Eng^1_M (14)	.034	.334	.372	.156	.200	.241
So St_1(2)	.369	.591*	.546*	.541	.656	.658
So St^1_M(15)	.365	.492	.441	.471	.614	.584
$Chem_1$ (3)	.406	.397*	.303	.367	.341*	.487
$Chem^1_M$ (16)	.338	.170	.160	.343	.082	.333
Sci_1 (4)	.288	.438	.366*	.587	.347	.516
Sci^1_M (17)	.229	.343	.222	.583	.221	.417
Sci Mn_1 (5)	.420	.512*	.406	.584	.418*	.610*
Sci Mn^1_M (18)	.294	.313	.254	.525	.205	.431
$Math_1$(6)	.420	.311	.101	.388	.099	.403
$Math^1_M$ (19)	.450	.238	.122	.343	.114	.398
For L_1 (7)	.383	.286	.480	.387	.329	.483
For L^1_M (20)	.389	.275	.475	.456	.362	.506
Gd XII Mn_1 (8)	.455	.562	.531	.596	.473	.674
Gd XII Mn^1_M (21)	.479	.482	.481	.637	.425	.660

* t significant at .05 level, two-tailed test.

TABLE XII

COMPARATIVE CORRELATION COEFFICIENTS OF GRADE XII FIRST-WRITING (n_1) SCORES AND GRADE XII MATRICULATION (n_M) SCORES WITH CRITERION SCORES
1956-57 TO 1963-64
MALE SUBGROUPS
N = 105

Predictors	Criteria (A) Chem	(B) Eng	(C) Psy	(D) Zoo	(E) In PE	(F) BPE 1
Eng_1 (1)	.068	.477	.383	.238	.338	.371*
Eng_M (14)	-.058	.406	.321	.127	.220	.221
So St_1 (2)	.199	.243	.379	.297	.405	.397
So St_M (15)	.131	.227	.285	.251	.349	.310
$Chem_1$ (3)	.425	.247	.234*	.236	.273*	.433*
$Chem_M$ (16)	.299	.051	.009	.129	.039	.210
Sci_1 (4)	.350	.188	.305	.355	.204	.431
Sci_M (17)	.251	.155	.300	.331	.081	.345
Sci Mn_1 (5)	.432	.241	.297	.324	.273*	.481
Sci Mn_M (18)	.406	.167	.249	.313	.096	.407
$Math_1$ (6)	.482	.180	.294	.179*	.246	.440*
$Math_M$ (19)	.361	.061	.171	.014	.115	.246
For L_1 (7)	.388	.254	.177	.194	.216	.370
For L_M (20)	.305	.172	.151	.197	.199	.295
Gd XII Mn_1 (8)	.471	.365	.409	.340	.392	.576
Gd XII Mn_M (21)	.435	.321	.381	.328	.311	.518

* t significant at .05 level, two-tailed test.

TABLE XIV

COMPARATIVE CORRELATION COEFFICIENTS OF GRADE XII FIRST-WRITING (n_1) SCORES AND GRADE XII MATRICULATION (n_M) SCORES WITH CRITERION SCORES
1956-57 TO 1963-64
TOTAL GROUP
N = 159

Predictors	Criteria (A) Chem	(B) Eng	(C) Psy	(D) Zoo	(E) In PE	(F) BPE 1
Eng_1 (1)	.001	.524	.407	.206	.352	.344*
Eng_M (14)	-.065	.451	.351	.124	.269	.242
So St_1 (2)	.241	.400	.442*	.375	.510	.502
So St_M (15)	.209	.340	.344	.327	.453	.423
$Chem_1$ (3)	.397	.311*	.261*	.271	.307*	.451*
$Chem_M$ (16)	.323	.051	.046	.201	.029	.245
Sci_1 (4)	.254	.374	.338	.396	.310*	.457
Sci_M (17)	.181	.323	.287	.391	.197	.377
Sci Mn_1 (5)	.369	.393*	.343	.381	.357*	.520
Sci Mn_M (18)	.332	.268	.262	.379	.168	.423
$Math_1$ (6)	.440	.236*	.249	.232	.218	.427*
$Math_M$ (19)	.395	.090	.147	.116	.096	.289
For L_1 (7)	.306	.358	.287	.230	.309	.406
For L_M (20)	.293	.273	.272	.271	.293	.379
Gd XII Mn_1 (8)	.385	.499	.451	.387	.457	.593
Gd XII Mn_M (21)	.401	.440	.425	.424	.389	.576

* t significant at .05 level, two-tailed tests.

Only nine of the forty-eight matriculation coefficients were larger than the corresponding first-writing coefficients for the female subgroup, but none significantly so. However, eight of the first-writing coefficients were significantly larger than the corresponding matriculation coefficients for this subgroup.

For the total group, only three of the forty-eight matriculation coefficients were larger than the corresponding matriculation coefficients, but none significantly so. Conversely though, eleven first-writing coefficients were significantly larger than the corresponding matriculation coefficients for the total group.

First-writing variables were not consistently superior predictors for specific criteria for all groups in the study. The only criterion for which first-writing predictions were superior for all study groups was English, while the only criterion for which all first-writing predictors were not superior for at least one study group was zoology. For all the study groups combined, differences in correlation coefficient size favoring first-writing predictors were significant at the .05 level for seven intercorrelations with the English criterion and for six intercorrelations with the psychology, introductory physical education, and the BPE 1 mean criteria. There was only one significant difference in correlation coefficient size for intercorrelations with the zoology criterion and no such difference was significant for intercorrelations with the chemistry criterion.

Certain grade XII first-writing variables consistently appeared to be superior predictors to matriculation variables for all criteria for all groups. Correlation coefficients of first-writing scores in the English, social studies, chemistry, science, and science mean pre-

dictor variables were larger than the corresponding matriculation scores' correlation coefficients with all the criteria in each group. Many of these differences were significant at the .05 level. First-writing mathematics and grade XII mean scores were consistently superior predictors for all criteria for the male subgroup but not for the female subgroup. Foreign language first-writing scores were not consistently superior to matriculation scores as predictors for either the male or female subgroup, and no differences in coefficient sizes were significant.

Longitudinal Prediction. To determine if there was an indication of decreased predictive efficiency through the use of longitudinal prediction as defined in this study, correlation coefficients were compared with those derived in other studies at UA employing similar populations and variables. Direct numerical comparisons were used because no other study group was directly comparable to the BPE 1 group used in the present study and so more sophisticated statistical treatment was deemed inappropriate.

In the present study, multiple correlation coefficients for the individual criterion courses from the grade XII prediction battery for the three study groups were: female—range 0.624 to 0.708, median 0.639; male—range 0.428 to 0.555, median 0.502; and total—range 0.481 to 0.576, median 0.532. In other studies at UA which implemented prediction to individual criterion courses, correlation coefficients were: Black (5) using 1956-57 general university population—range 0.298 to 0.720, median 0.653; Black (7) using 1962-63 engineering population--range 0.597 to 0.760, median 0.687; and Zurowsky (54) using 1956-57 general university population—range 0.526 to 0.720, median 0.655. Since there was no female-male subgroup breakdown in the latter three investigations, only compari-

sons with the total group of the present study were used here. The median coefficient for predictors of the present study group fell within the range of predictor coefficients for Black's and Zurowsky's studies which used the general university population, but was smaller than the median for predictors of all three investigations.

Correlation coefficients for first-year average from grade XII predictors in the present study for the total group was 0.610. In similar UA studies, correlation coefficients with first-year average were: Zurowsky (54), using 1956-57 general university population—0.656; Black (7), using 1962-63 engineering population—0.762; Mack (40), using five 1960-61 faculty groups—0.508 for arts, 0.715 for science, 0.450 for education, 0.549 for engineering, and 0.647 for an other faculties group; and Knowles (35) using four 1962-63 faculty groups and a total group—0.653 for arts, 0.737 for science, 0.596 for education, 0.750 for engineering, and 0.636 for all groups combined. The multiple correlation coefficient for first-year average for the present study group was slightly smaller than that for the total group in all cases but was larger than that for three of five faculty groups in Mack's study and for one of four faculty groups in Knowles' investigation. In both of these cases, the multiple correlation coefficient for the BPE 1 mean was larger than that for the first-year mean for the education population.

Knowles (35) used a sex-group division of faculty groups and computed multiple correlation coefficients as follows: arts—females 0.746, males 0.558; science—females 0.796, males 0.722; education—females 0.634, males 0.470; engineering—males only 0.750; and the combined faculty groups—females 0.679, males 0.635. Corresponding multiple correlation coefficients for BPE 1 means for females and males were 0.754 and 0.586 respectively. The first-year mean coefficient for the BPE female

group was larger than three of four coefficients for Knowles' female groups, but the coefficient for the BPE male group was larger than only two of five coefficients for the Knowles' male groups.

Regression Equations. Using the six grade XII individual predictors, regression equations were developed for each criterion for the female, male, and total groups, as shown in Table XV.

The standard error of estimate (corrected) was calculated for each equation. Prediction error was smallest for equations predicting the BPE 1 mean, and was only slightly larger for the psychology and English criteria. The prediction error for the chemistry criterion was much larger than that computed for the prediction of any other criterion. Characteristically, the standard error of estimate was smaller for the female subgroup than the male subgroup, with prediction of the chemistry and English criteria the only exceptions.

In developing the six-variable multiple correlation coefficients for the 21 equations shown in Table XV, the relative contributions of the grade XII variables, as measured by the number of times each was assessed a predictor weight, was as follows (number in parentheses): social studies (20), English (19), science (18), foreign language (16), mathematics (16), and chemistry (15).

Another set of regression equations for the different criteria for the female, male, and total groups was developed using the six grade XII individual predictors and the four individual standardized predictors. These 21 equations, with the standard error of estimate (corrected) for each, are shown on Table XVI. Prediction error was smallest for the BPE 1 mean and the psychology criteria and was by far the largest for the chemistry criterion. Again, the standard error of estimate was smaller

REGRESSION EQUATIONS FOR EACH CRITERION VARIABLE
FROM GRADE XII PREDICTOR VARIABLES*
FOR FEMALE, MALE, AND TOTAL GROUPS
1956-57 TO 1963-64

*

Criterion	Group	R	Predictor Weights						Constant	Standard Error of Estimate (Corre.)
			Eng (1)	So St (2)	Chem (3)	Sci (4)	Math (6)	For L (7)		
A. Chem	F	.624	-.632	.546	.274	-.123	.495	.345	- 0.886	14.39
	M	.555	-.154	-.080	.189	.082	.381	.231	20.604	13.87
	T	.532	-.295	.121	.310	-.054	.404	.155	18.413	14.44
B. Eng.	F	.639	.070	.399	.151	.060	.095	-.056	12.212	7.93
	M	.502	.329	....	....	.033	....	.091	26.368	7.63
	T	.576	.292	.121	.032	.098	....	.050	18.028	7.96
C. Psy	F	.638	.093	.279	.031	....	-.118	.170	29.791	6.29
	M	.503	.191	.208	-.078	.128	.087	-.029	28.298	7.39
	T	.511	.151	.214	....	.075	.029	....	30.015	7.14
D. Zoo	F	.678	-.166	.297	.079	.298	.133	.092	6.125	8.06
	M	.415	.127	.195	....	.269	-.043	....	21.139	10.18
	T	.450	....	.246	....	.249	....	....	22.773	9.73
D. Zoo*	F	.691	-.107	.263	....	.411	.185	.194	-10.313	7.93
	M	.428	.120	.304	.130	.396	-.101	.035	- 3.045	10.11
	T	.481	....	.292	.166	.335	....	.060	- 2.392	9.56
E. Intro PE	F	.708	-.232	.718	.092	-.067	-.089	.092	34.497	7.55
	M	.461	.176	.294	....	....	.067	....	30.846	9.03
	T	.534	.120	.397	.069	....	....	....	27.989	8.78
F. BPE 1 Mn	F	.754	-.167	.439	.141	.045	.126	.108	13.858	6.02
	M	.586	.132	.101	.032	.112	.108	.053	24.817	6.41
	T	.610	.043	.188	.079	.092	.107	.044	23.021	6.49

*Predictor variables used were first-writing scores except for the second set of equations for the Zoology criterion in which the corresponding matriculation scores were used.

TABLE XVI

REGRESSION EQUATIONS FOR EACH CRITERION VARIABLE
FROM GRADE XII AND STANDARDIZED PREDICTOR VARIABLES
FOR FEMALE, MALE, AND TOTAL GROUPS
1956-57 to 1963-64

Criterion	Group	R	Predictor Weights										Constant	Standard Error of Estimate (Corre.)
			Eng (1)	So St (2)	Chem (3)	Sci (4)	Math (6)	For L (7)	Coop-C2 (9)	Coop-A (10)	ACE-Q (11)	ACE-L (12)		
A. Chem	F	.629	-.620	.535	.262	-.120	.486	.339	.189	....	....	....	- 4.450	14.95
	M	.571	....	-.085	.193	.085	.382	.232	-.250	-.031	-.163	....	28.433	14.02
	T	.534	-.276	.102	.306	...	.399	.153	....	-.072	....	....	23.397	14.61
B. Eng	F	.660	....	.307	.159	.065	.113	-.041	.299	....	....	....	12.623	8.08
	M	.541	.243	-.032	.028	....	....	.090	.045	....	....	.180	20.965	7.60
	T	.605	.204	.064	.037	.093	....	.057	.124	.034	....	.120	11.886	7.86
C. Psy.	F	.741	....	.104	.084	....	-.113	.204	.408	-.022	-.191	.202	28.185	5.72
	M	.574	.121	.129	.034	.125	.064	....	....	.047	-.276	.242	26.831	7.17
	T	.584	.050	.151	....	.068	.036	.026	.173	....	-.171	.205	28.611	6.83
D. Zoo	F	.729	-.294	.266	....	.299	.161	.073	.215	.185	....	-.055	- 2.475	7.83
	M	.446	.075	.144	....	.313	-.039	.034	....	-.042	-.172	.206	23.192	10.87
	T	.470	-.057	.230	....	.234	....	....	.083	....	....	.135	17.283	9.74
D. Zoo*	F	.770	-.280	.134	....	.406	.243	.184	.459	.174	-.054	-.089	-16.560	7.30
	M	.465	....	.253	.117	.396	-.110	.069	....	-.046	....	.235	- 3.529	10.13
	T	.515	-.108	.285	.175	.326	-.038	.058	.099	....	....	.165	- 5.785	9.46
E. Intro PE	F	.722	-.274	.647	.106	-.053	-.129	.110	....	....	.041	.188	26.787	7.72
	M	.467	.182	.303	....	....	.069	....	-.055	.027	.055	....	31.025	9.22
	T	.543	.064	.383	.061	....	....	....	....	.073	-.051	.052	23.827	8.84
F. BPE 1 Mn	F	.779	.206	.371	.131	.042	.133	.112	.181	.025	....	.070	8.658	6.00
	M	.607	.123	.068	.044	.133	.101	.063	....	....	-.165	.101	26.411	6.91
	T	.627	....	.179	.081	.088	.102	.046	.076	....	-.043	.094	20.400	6.46

*Grade XII predictor variables used were first-writing scores except for the second set of equations for the Zoology criterion in which the corresponding matriculation scores were used.

for predictions for the females than the males except for the chemistry and English criteria.

In developing the ten-variable multiple correlation coefficients for the 21 equations shown in Table XVI, the relative contributions of the grade XII and standardized predictor variables, as measured by the number of times each was assessed a predictor weight, was as follows (number in parentheses): social studies (21), foreign language (17), mathematics (17), science (16), ACE-L (16), English (16), chemistry (15), Coop-C2 (14), Coop-A (12), and ACE-Q (11).

It appeared, from both sets of equations, that considerable emphasis could be placed on the predictive attributes of the social studies predictor to all parts of the BPE 1 program. Linguistic attributes, as measured by the English and ACE-L predictors, also seemed to merit consistent emphasis, slightly more so than the science, foreign language, and mathematics predictor variables. Chemistry was the least-frequent occurring grade XII predictor and, except for the ACE-L variable, the standardized predictors did not contribute consistently as predictor weights for the various regression equations.

Prediction of Awarding a BPE Degree. A physical education baccalaureate was conferred on 117 of the 159 members of the study group up to and including fall convocation 1968. Degrees were awarded to 43 of the 54 females (80 per cent) and 74 of the 105 males (70 per cent) in the study group. A complete summary of the number of BPE degrees awarded to members of the female, male, and total groups, by year of registration, is shown in Table XVII.

The occurrence of an eventual awarding of a BPE degree was correlated biserially with academic performance on each predictor variable

TABLE XVII

BPE DEGREES CONFERRED, MEMBERS OF INITIAL STUDY GROUPS ONLY,
UP TO AND INCLUDING FALL CONVOCATION 1968

Term Reg.	Female Subgroup No. Reg.	Female Subgroup BPE Conf.	Male Subgroup No. Reg.	Male Subgroup BPE Conf.	Total Group No. Reg.	Total Group BPE Conf.
56-57	5	4	7	5	12	9
57-58	5	3	5	4	10	7
58-59	0	0	3	3	3	3
59-60	6	5	10	8	16	13
60-61	6	3	21	17	27	20
61-62	8	7	14	10	22	17
62-63	7	6	17	9	24	15
63-64	17	15	28	18	45	33
TOTALS	54	43	105	74	159	117

for members of the female, male, and total groups. To determine the credibility of apparent correlations with the criterion, each coefficient was tested for significance at the .05 and .01 levels. A complete listing of biserial correlation coefficients of all predictors with the criterion is shown in Table XVIII.

All of the correlation coefficients of the BPE 1 variables predicted significantly to the criterion for the female subgroup and the total group. However, only three of the BPE 1 variables (chemistry, introductory physical education, and BPE 1 mean) predicted significantly to the criterion for the male subgroup. Five of the eight grade XII first-writing predictors (English, social studies, science, science mean, and grade XII mean) correlated significantly with the criterion for the female subgroup but only the first-writing science variable correlated significantly for the male subgroup. Four of the eight grade XII matriculation predictors (English, social studies, science, and grade XII mean), correlated significantly with the criterion for the female subgroup but, of these four, the social studies variable did not predict significantly for the male subgroup. The Coop-C2, Coop-A, and the ACE-L standardized predictor variables correlated significantly with the criterion for the female subgroup but only the Coop-A variable correlated significantly for the male subgroup.

The largest single biserial correlation coefficient with the criterion of receiving a BPE degree was 0.757 for the grade XII first-writing social studies variable for the female subgroup. Three other coefficients of notable size for the female subgroup were two BPE 1 variables, zoology (0.670) and BPE 1 mean (0.676), and the Coop-C2 standardized variable (0.610). Comparatively, the largest coefficient for the male subgroup was

TABLE XVIII

BISERIAL CORRELATION COEFFICIENTS FROM ACADEMIC PERFORMANCE ON EACH VARIABLE AND THE EVENTUAL CONFERRING OF THE BPE DEGREE FOR THE 1956-57 TO 1963-64 STUDY GROUPS

	Group		
	Female (N = 54)	Male (N = 105)	Total (N = 159)
Variable	r_b	r_b	r_b
A. Chem	.399**	.361**	.355**
B. Eng	.536**	-.026	.189*
C. Psy	.535**	.129	.258**
D. Zoo	.670**	.122	.278**
E. Intro PE	.543**	.248*	.359**
F. BPE 1 Mn	.676**	.257**	.401**
1. Eng_1	.475**	-.007	.168*
2. So St_1	.757**	.046	.283**
3. $Chem_1$	.061	.157	.150
4. Sci_1	.490**	.199*	.320**
5. Sci Mn_1	.352*	.185	.258**
6. $Math_1$	.063	.142	.137
7. For L_1	.068	.039	.094
8. Gd XII Mn_1	.455*	.138	.258**
9. Coop-C2	.610**	-.055	.142
10. Coop-A	.442**	-.240*	-.010
11. ACE-Q	-.029	.003	-.020
12. ACE-L	.357**	-.174	-.017
13. ACE-T	.198	-.120	-.022
14. Eng_M	.323*	-.235*	-.005
15. So St_M	.546**	-.027	.166*
16. $Chem_M$	.000	.012	-.008
17. Sci_M	.360**	.256**	.319**
18. Sci Mn_M	.198	.227*	.239**
19. $Math_M$	-.080	.042	-.002
20. For L_M	.041	.112	.123
21. Gd XII Mn_M	.310*	.072	.182*

* Correlation significant at .05 level.

** Correlation significant at .01 level.

for the BPE 1 chemistry variable (0.361), followed by BPE 1 mean (0.257) and grade XII matriculation science variable (0.256).

Biserial correlation coefficients with the criterion for the male subgroup were smaller characteristically than those for the female subgroup. Eight of the variables for the male subgroup correlated negatively with the criterion, two significantly (Coop-A at -0.240 and grade XII matriculation English at -0.235). It was notable that those factors which were purported to measure communicative language abilities—BPE 1 English, grade XII first-writing and matriculation English, Coop-C2, Coop-A, and ACE-L—correlated negatively with the criterion for the male subgroup but positively for the female subgroup.

Study Group 1968-69

Means and standard deviations of scores in all variables for the female and male subgroups and the total group are shown in Table XIX. Complete intercorrelation matrices for the female subgroup, male subgroup, and total group are shown in Appendix B in Tables XXX, XXXI, and XXXII, respectively.

Female-Male Academic Performance. There was an apparent difference in the performance level of members of the female and male subgroups on the criterion variables of this study. Mean scores for the female subgroup were larger than those for the male subgroup for all six of the criterion variables. Differences between mean scores were significant at the .05 level of confidence for three criteria—science option, English, and BPE 1 mean.

There was, however, no consistent difference apparent in the academic performances of members of these two subgroups on the predictor variables of this study. Mean scores for females were larger for seven

TABLE XIX

MEANS, STANDARD DEVIATIONS, ALL VARIABLES
1968 - 69 STUDY GROUP

Variable	Female Subgroup N = 25 Mean	Std Dev	Male Subgroup N = 40 Mean	Std Dev	Total Group N = 65 Mean	Std Dev
A. Sci Op	5.08*	1.26	4.10*	1.87	4.48	1.73
B. Eng	5.64**	1.09	4.25**	1.68	4.78	1.63
C. Psy	4.96	1.11	4.43	1.56	4.63	1.43
D. A or S Op	5.28	1.08	4.88	1.35	5.03	1.26
E. Intro PE	5.92	1.06	5.43	1.45	5.62	1.33
F. BPE 1 Mn	5.29**	0.78	4.50**	1.33	4.80	1.21
1. Eng_1	65.80*	9.83	60.60*	10.46	62.60	10.53
2. So St_1	61.36	11.42	64.20	9.71	63.11	10.49
3. $Chem_1$	64.96	8.47	62.05	10.10	63.17	9.62
4. Sci_1	61.28	9.25	64.45	10.15	63.23	9.93
5. Sci Mn_1	63.08	7.09	63.38	9.15	63.26	8.42
6. $Math_1$	62.24	9.03	62.60	10.39	62.46	9.89
7. Gd XII Mn_1	63.00	6.84	62.48	6.52	62.68	6.65
8. Eng_M	65.96	9.65	62.08	10.12	63.57	10.12
9. So St_M	64.24	9.12	65.50	8.36	65.02	8.68
10. $Chem_M$	66.04	7.67	64.70	7.88	65.22	7.83
11. Sci_M	64.12	7.03	66.65	7.72	65.68	7.56
12. Sci Mn_M	65.16	5.73	65.78	6.60	65.54	6.29
13. $Math_M$	64.12	8.44	63.85	9.45	63.95	9.07
14. Gd XII Mn_M	64.60	5.14	64.30	5.38	64.42	5.29

*Difference between means for female and male subgroups significant at .05 level.

**Difference between means for female and male subgroups significant at .01 level.

predictors while mean scores for males were larger for seven predictors. Only one difference between female-male predictor mean scores was significant. The mean score for the first-writing English variable for the female subgroup was significantly larger than the corresponding score for the male subgroup.

In the area of female-male academic performance, there were two strong similarities between the current study group and the initial one. First, female performance in the criterion variables of the study was superior to that of the males and, second, female performance on all of the English variables was significantly superior to that of the males.

Female-Male Academic Prediction. Zero-order correlation coefficients between predictor variable scores and criterion variable scores characteristically were larger for the female subgroup than the male subgroup. In all, female subgroup scores correlated more highly with the criterion for 58 of 84 measures—about 70 per cent of the total. Five of these differences were significant at the .05 level of confidence. No differences favoring the male subgroup were found to be significant. Comparative zero-order correlation coefficients between all criterion and predictor variables for the female and male subgroups are shown in Table XX.

Consistent differences in coefficient size, favoring the female over the male subgroup, were apparent for three of the six criterion variables—psychology, introductory physical education, and BPE 1 mean. Correlation coefficients with the other three criteria—science option, English, and arts or science option—were not consistently larger for either subgroup, and no difference between corresponding coefficients with these criteria was significant. Of the four criteria which remained un-

TABLE XX

COMPARATIVE ZERO-ORDER CORRELATION COEFFICIENTS
BETWEEN CRITERION VARIABLES AND ALL PREDICTORS
FOR 1968-69 FEMALE AND MALE SUBGROUPS

		Criteria					
		(A)	(B)	(C)	(D)	(E)	(F)
Predictors		Sc Op	Eng	Psy	A-S Op	In PE	BPE 1 Mn
1. Eng_1	r_F	.340	.221	.544	.266	.126	.466
	r_M	.278	.288	.234	.354	.447	.352
2. So St_1	r_F	.412	.184	.722*	.210	.381	.551
	r_M	.359	.365	.342	.408	.232	.429
3. $Chem_1$	r_F	.236	-.019	.399	.106	.340	.281
	r_M	.392	.067	.146	.045	.021	.197
4. Sci_1	r_F	.406	.268	.425	.305	.248	.496*
	r_M	.144	-.020	-.045	-.199	-.217	-.035
5 Sci Mn_1	r_F	.411	.112	.492	.248	.370	.466
	r_M	.280	.022	.052	-.090	-.105	.081
6. $Math_1$	r_F	.226	.212	.498	.272	.203	.420
	r_M	.412	.212	.243	.245	.163	.335
7. Gd XII Mn_1	r_F	.454	.193	.673*	.315	.333	.582
	r_M	.489	.249	.272	.269	.267	.390
8. Eng_M	r_F	.332	.230	.525	.266	.129	.460
	r_M	.199	.113	.120	.269	.389	.220
9. So St_M	r_F	.190	.250	.659*	.246	.401	.490
	r_M	.307	.311	.238	.301	.206	.343
10. $Chem_M$	r_F	.140	.026	.192	.081	.386	.186
	r_M	.301	-.019	.090	.027	.193	.140
11. Sci_M	r_F	.053	-.047	.144	-.041	.389*	.084
	r_M	.042	-.188	-.110	-.194	-.137	-.127
12. Sci Mn_M	r_F	.148	-.106	.189	.006	.486	.137
	r_M	.186	-.119	.004	-.071	.039	.014
13. $Math_M$	r_F	.127	.126	.226	.146	.235	.228
	r_M	.338	.161	.243	.347	.305	.331
14. Gd XII Mn_M	r_F	.326	.117	.571	.237	.437	.466
	r_M	.350	.119	.238	.299	.392	.317

*Difference between corresponding correlation coefficients for female and male subgroups significant at .05 level of confidence.

changed in definition from the initial study group, the English variable only did not seem to retain its level of superior predictability for females over males.

Differences in female-male predictability were also apparent with the grade XII predictor variables. Intercorrelation coefficients with the first-writing and matriculation chemistry, science, and science mean predictor variables were consistently larger for the female subgroup than the male subgroup. Other variables did not predict consistently. In particular, first-writing mathematics scores predicted more efficiently for the females than the males for five of six criteria, while matriculation mathematics scores predicted more efficiently for males than females for all six criteria.

In determining the most efficient single predictor for each criterion, there was no consistent pattern favoring the hypothesis of greater academic predictability of females as coefficients for males were larger for three of six variables. However, of the four criteria unchanged in definition from the initial study group, coefficients were larger for females than males for the psychology, introductory physical education, and BPE 1 mean variables. The superior level of predictability for females over males seemed to have decreased only for the English criterion.

As with the initial study group, it appeared that there was a strong relationship between the predictive efficiency of certain variables and the sex of the subgroup to which the prediction was directed and, also, that certain variables predicted to a broad range of criteria. The grade XII first-writing mean was the most efficient single predictor for three of six criteria for the female subgroup but for only one cri-

terion for the male subgroup. In an almost direct contrast to the initial study group, the first-writing social studies variable was the most efficient predictor for four criteria for the male subgroup but for only one of the criteria for the female subgroup. A complete comparison of the largest zero-order correlation coefficients with each criterion and for each subgroup is shown in Table XXI.

Multiple correlation coefficients with each criterion were developed separately for the female and male subgroups from a combination of five grade XII predictor variables. Multiple correlation coefficients for the female subgroup were larger than corresponding coefficients for the male subgroup for only three of six variables over-all but for three of the four criteria unchanged by definition from the initial study group. In contrast to the initial group findings, the multiple correlation coefficient for the English criterion was larger for the male subgroup than the female subgroup. However no differences between corresponding correlation coefficients for female and male subgroups were significant at the .05 level of confidence. The largest multiple correlation coefficients for each criteria from the grade XII predictors for the female and male subgroups are shown in Table XXII.

Prediction From Grade XII First-Writing and Matriculation Scores. A complete comparative listing of grade XII first-writing and matriculation zero-order correlation coefficients for each criterion for the female subgroup, male subgroup, and total group is shown in Table XXIII, XXIV, and XXV respectively.

Zero-order correlation coefficients between first-writing predictor scores and criterion scores characteristically were larger than coefficients between matriculation predictor scores and the same criterion

TABLE XXI

LARGEST ZERO-ORDER CORRELATION COEFFICIENTS
FOR EACH CRITERION VARIABLE FOR 1968-69
FEMALE, MALE, AND TOTAL GROUPS

BPE 1	Female Subgroup N = 25		Male Subgroup N = 40		Total Group N = 65	
Criterion Variables	r	Predictor	r	Predictor	r	Predictor
A. Sci Op	.454	(Gd XII Mn_1)	.489	(Gd XII Mn_1)	.461	(Gd XII Mn_1)
B. Eng	.268	(Sci_1)	.365	(So St_1)	.334	(Eng_1)
C. Psy	.722	(So St_1)	.342	(So St_1)	.424	(So St_1)
D. A-S Op	.315	(Gd XII Mn_1)	.408	(So St_1)	.349	(Eng_1)
E. In PE	.486	(Sci Mn_M)	.447	(Eng_1)	.400	(Gd XII Mn_M)
F. BPE 1 Mn	.582	(Gd XII Mn_1)	.429	(So St_1)	.419	(Eng_1)

*Subscript 1: Coefficient calculated from grade XII first-writing scores.

Subscript M: Coefficient calculated from grade XII matriculation scores.

TABLE XXII

COMPARATIVE MULTIPLE CORRELATION COEFFICIENTS (R) OF
GRADE XII PREDICTOR VARIABLES WITH
ALL CRITERION VARIABLES FOR
FEMALE AND MALE SUBGROUPS
1968-69

Criterion Variables		Grade XII (5 Variables)
A. Sci Op	R_F	.472
	R_M	.535
B. Eng	R_F	.395
	R_M	.429
C. Psy	R_F	.758
	R_M	.416
D. A or S Op	R_F	.396
	R_M	.566
	R_M	.574
E. Intro PE	R_F	.459
	R_F	.585
	R_M	.551
F. BPE 1 Mn	R_F	.634
	R_M	.546

Grade XII first-writing predictor variables used except for second coefficient for male subgroup for Arts or Science Option variable and for second coefficient for female subgroup for Introductory PE variable. In the latter cases, corresponding matriculation scores were used.

*No differences between corresponding correlation coefficients for female and male subgroups were significant at .05 level of confidence.

TABLE XXIII

COMPARATIVE ZERO-ORDER CORRELATION COEFFICIENTS
OF GRADE XII FIRST-WRITING (n_1) SCORES AND
GRADE XII MATRICULATION ($\bar{n}_M$) SCORES
WITH CRITERION SCORES
1968-69 FEMALE SUBGROUP
N = 25

	Criteria					
Predictors	(A)Sc Op	(B)Eng	(C)Psy	(D)A-S Op	(E)In PE	(F)BPE 1 Mn
Eng_1 (1)	.340	.221	.544	.266	.126	.466
Eng_M^1 (8)	.332	.230	.525	.266	.129	.460
So St_1 (2)	.412*	.184	.722	.210	.381	.551
So St_M^1 (9)	.190	.250	.659	.246	.401	.490
$Chem_1$ (3)	.236	-.019	.399	.106	.340	.281
$Chem_M^1$ (10)	.140	.026	.192	.081	.386	.186
Sci_1 (4)	.406*	.268	.425	.305	.248	.496*
Sci_M^1 (11)	.053	-.047	.144	-.041	.389	.084
Sci Mn_1 (5)	.411	.112	.492*	.248	.370	.466*
Sci Mn_M^1 (12)	.148	-.106	.189	.006	.486	.137
Math $_1$ (6)	.226	.212	.498*	.272	.203	.420
Math $_M^1$ (13)	.127	.126	.226	.146	.235	.228
Gd XII Mn_1 (7)	.454	.193	.673	.315	.333	.582
Gd XII Mn_M^1 (14)	.326	.117	.571	.237	.437	.466

*t significant at .05 level, two-tailed test.

TABLE XXIV

COMPARATIVE ZERO-ORDER CORRELATION COEFFICIENTS OF GRADE XII FIRST-WRITING (n_1) SCORES AND GRADE XII MATRICULATION (n_M) SCORES WITH CRITERION SCORES
1968-69 MALE SUBGROUP
N = 40

	Criteria					
Predictors	(A)Sc Op	(B)Eng	(C)Psy	(D)A-S Op	(E)In PE	(F)BPE 1 Mn
Eng_1 (1)	.278	.288*	.23	.354	.447	.352
Eng_M^1 (8)	.199	.113	.120	.269	.389	.220
$So\ St_1$ (2)	.359	.365	.342	.408	.232	.429
$So\ St_M^1$ (9)	.307	.311	.238	.301	.206	.343
$Chem_1$ (3)	.392	.067	.146	.045	.021	.197
$Chem_M^1$ (10)	.301	-.019	.090	.027	.193	.140
Sci_1 (4)	.144	-.020*	-.045	-.199	-.217	-.035
Sci_M^1 (11)	.042	-.188	-.110	-.194	-.137	-.127
Sci_1 (5)	.280	.022	.052	-.090	-.105	.081
Sci_M^1 (12)	.186	-.119	.004	-.071	.039	.014
$Math_1$ (6)	.412	.212	.243	.245	.163	.335
$Math_M^1$ (13)	.338	.161	.243	.347	.305	.331
Gd XII Mn_1 (7)	.489	.249	.272	.269	.267	.390
Gd XII Mn_M^1 (14)	.350	.119	.238	.299	.392	.317

*t significant at .05 level, two-tailed test.

TABLE XXV

COMPARATIVE ZERO-ORDER CORRELATION COEFFICIENTS OF GRADE XII FIRST-WRITING (n_1) SCORES AND GRADE XII MATRICULATION[1] (n_M) SCORES WITH CRITERION SCORES 1968-69 TOTAL GROUP N = 65

Predictors	Criteria (A)Sc Op	(B)Eng	(C)Psy	(D)A-S Op	(E)In PE	(F)BPE 1 Mn
Eng_1 (1)	.339	.334*	.352*	.349	.376	.419*
Eng_M^1 (8)	.273	.206	.264	.288	.331	.316
$So\ St_1$ (2)	.310	.212	.424	.301	.246	.374
$So\ St_M^1$ (9)	.233	.228	.348	.263	.248	.328
$Chem_1$ (3)	.373	.101	.235	.084	.132	.247
$Chem_M^1$ (10)	.263	.029	.132	.057	.260	.167
Sci_1 (4)	.161	-.013	.059	-.064	-.106	.041
Sci_M^1 (11)	-.002	-.200	-.065	-.168	-.012	-.120
$Sci\ Mn_1$ (5)	.295	.032	.159	.002	.016	.151
$Sci\ Mn_M^1$ (12)	.155	-.124	.046	-.054	.153	.025
$Math_1$ (6)	.341	.184	.304	.247	.168	.326
$Math_M^1$ (13)	.271	.143	.236	.283	.281	.290
$Gd\ XII\ Mn_1$ (7)	.461*	.222	.393	.285	.286	.418
$Gd\ XII\ Mn_M^1$ (14)	.333	.117	.333	.279	.400	.338

*t significant at .05 level, two-tailed test.

scores. There were 42 pairs of correlation coefficients for each group. Of these, the first-writing coefficient was the larger in 31 (74 per cent), 33 (78 per cent), and 34 (81 per cent) cases for the female subgroup, male subgroup, and total group respectively. These percentages were slightly smaller than the corresponding percentages of the initial study group.

The first-writing coefficient was significantly larger than the corresponding matriculation coefficient for ten correlations in all. In no case was the matriculation coefficient significantly larger than the first-writing coefficient.

First-writing coefficients were larger than matriculation coefficients in every case for the science option, psychology, and BPE 1 mean criterion variables. Nine of these differences were significant. Conversely, matriculation coefficients were consistently larger than first-writing coefficients for the introductory physical education criterion, though no difference was significant. Excepting for the latter change involving the introductory physical education criterion, these findings were consistent with those for the initial study group.

Although all grade XII first-writing variables appeared to be superior predictors to matriculation variables for some groups, only the English first-writing variable was consistently superior for all groups. The English first-writing variable was significantly superior to the matriculation variable for predicting to three of six criteria for the total group. These findings were consistent with those for the initial study group.

Regression Equations. Regression equations were developed from the five grade XII individual predictor for each criterion for the fe-

male, male, and total groups, as shown in Table XXVI.

The standard error of estimate (corrected) was calculated for each equation. Prediction error was smallest for equations predicting the BPE 1 mean, and was only slightly larger for the arts or science option and the introductory physical education criteria. The prediction errors for the science option and the English criteria were larger than those computed for the other variables. The standard error of estimate was smaller for the female subgroup than the male subgroup for all equations. These findings corresponded to those of the initial study group, except that the standard error of equations predicting the English criterion appeared to be proportionately larger.

In developing the five-variable multiple correlation coefficients for the twenty equations shown in Table XXVI, the relative contribution of the predictor variables, as measured by the number of times each was assessed a predictor weight, was as follows (number in parentheses): English (20), science (19), social studies (18), mathematics (18), and chemistry (16). This ranking was very similar to that found for the initial study group.

Multiple correlation coefficients characteristically were smaller than those found for the initial study group. However, the coefficient for the psychology criterion for the current female subgroup was larger than for the initial group, as were the coefficients for two criteria for the current male subgroup, introductory physical education and arts or science option.

TABLE XXVI

REGRESSION EQUATIONS FOR EACH CRITERION VARIABLE
FROM GRADE XII PREDICTOR VARIABLES* FOR
1968-69 FEMALE, MALE, AND TOTAL GROUPS

Criterion Variables	Group	R	Predictor Weights: Eng (1)	So St (2)	Chem (3)	Sci (4)	Math (6)	Constant	Standard Error of Estimate (Corre.)
A. Sci Op	F	.472	.019	.024	....	.028	....	0.657	1.25
	M	.535	.026	.027	.042	-.025	.055	-3.633	1.69
	T	.475	.030	.019	.040	-.010	.027	-2.242	1.58
B. Eng	F	.395	.017	....	-.042	.025	.034	3.611	1.12
	M	.429	.036	.040	-.028	....	.036	-1.007	1.63
	T	.377	.051	.007	-.023	-.005	.032	0.927	1.57
C. Psy	F	.758	.024	.056	-.006	-.005	.019	-0.572	0.81
	M	.416	.011	.039	.016	-.031	.030	0.389	1.52
	T	.501	.026	.042	.006	-.017	.024	-0.462	1.29
D. A or S Op	F	.396	.016	-.010	-.015	.033	.028	2.018	1.11
	M	.566	.024	.036	....	-.048	.040	1.650	1.19
	M*	.574	.034	.026	-.025	-.050	.065	1.809	1.18
	T	.467	.036	.015	-.023	-.020	.041	1.977	1.15
E. Intro PE	F	.459	-.021	.035	.035	.005	-.008	3.136	1.06
	F*	.585	-.008	.035	.041	.044	....	-1.360	0.97
	M	.551	.062	....	-.015	-.034	.045	2.023	1.30
	T	.440	.038	.016	....	-.029	.021	2.757	1.24
F. BPE 1 Mn	F	.634	.016	.018	-.010	.021	.015	1.591	0.67
	M	.546	.029	.031	.004	-.026	.041	-0.414	1.19
	T	.524	.035	.021	....	-.016	.032	0.292	1.07

*Grade XII first-writing predictor variables used except for second equation for male subgroup for Arts or Science Option variable and for second equation for female subgroup for Introductory PE variable. In the latter cases, corresponding matriculation scores were used.

CHAPTER V

SUMMARY AND CONCLUSIONS

The summary section of this chapter included a review of the organization of the study and a general review of its findings. The conclusions section contained a presentation of conclusions reached regarding resolution of the primary and subsidiary problems of the study. This was followed by a brief discussion of possible applications of multiple regression analysis in a student counselling process preceding registration in the Faculty of Physical Education, UA.

Summary

This study, undertaken to examine certain aspects of academic prediction in the Faculty of Physical Education at UA, was completed in two parts. Two problems examined in part one were the feasibility of developing regression equations to predict certain measures of first-year academic performance, and the extent to which performance on the defined variables predicted the eventual conferring of a BPE degree. Resolution of the first problem required examination of: (a) the effects of treating men's and women's scores separately and collectively; (b) the predictive efficiency of grade XII first-writing scores compared to that of matriculation scores; and (c) the effectiveness of longitudinal prediction. The second part of the study consisted of an analysis of the utilization of applicable principles of academic prediction, previously developed in part one, on a single current BPE 1 class.

Academic performance of freshman students over an eight-year period, 1955-57 to 1963-64, was selected as the basis of part one of the study. This was the longest period during which the selected predictor

and criterion variables underwent no defined changes of prerequisites, content, or emphasis. Six criteria were defined from courses requisite in the BPE 1 program over this period. Similarly, twenty-one predictors were developed from grade XII first-writing and matriculation scores, and from standardized test scores.

The initial study group consisted of 159 students, 54 females and 105 males, who had scores recorded for all of the defined variables. Up to and including fall convocation 1968, 117 members of this initial study group, 43 females and 74 males, had been awarded a BPE degree at UA. Calculations for part one of the study were based on the recorded achievements of these students on the defined variables of the study.

The current study group consisted of 65 students, 25 females and 40 males, who registered in BPE 1 for the 1968-69 term at UA and who had scores recorded for all of the defined variables of this part of the study. Calculations were carried out for the female, male, and total groups using grade XII first-writing and matriculation predictors.

In summary form, the findings of the study were as follows:

1. Achievement scores on the BPE 1 criterion variables were consistently larger for females than males for both initial and current groups. These scores were more variable for males than females for the current group, but a corresponding trend was not apparent for the initial group.

2. Predictor variable scores consistently were larger for females than males for the initial group, but this trend was not clearly apparent for the current group.

3. Females consistently were more predictable academically than males for most criteria for both initial and current groups. This trend

was apparent, in particular, for the psychology, introductory physical education, and BPE 1 mean criteria. A superior level of predictability for females over males for the English criterion was apparent for the initial group but not for the current group.

4. The grade XII variables consistently predicted the criteria better for females than males for both initial and current groups, except for the English and mathematics predictors which showed inconsistent prediction patterns within and between groups.

5. Certain grade XII predictors, particularly the social studies and grade XII mean variables, predicted to a broad range of criteria for both the initial and current groups, but not equally so for the sex groups.

6. Multiple correlation coefficients with the criteria were larger for the females than the males for the initial group but an overall consistent pattern was not apparent for the current group. The pattern was apparent for this group, however, for three of the four criteria unchanged by definition from the initial group. The exception was the English criterion for which the coefficient for the male subgroup was larger than that for the female subgroup for the current study group.

7. Grade XII first-writing scores consistently correlated more highly with the criterion variables than did the corresponding matriculation scores. In a lone exception to this generalization, matriculation scores correlated more highly with the introductory physical education criterion for the current group only.

8. The size of longitudinally-derived multiple correlation coefficients with individual course criteria were within the range

but smaller than the median of coefficients found in other studies at UA. In the present study, coefficients with first-year average were as large or larger than the median for females but were slightly smaller than the median for males for comparable faculty groups. Multiple correlation coefficients for the criterion variables for the eight-year study group were, in most cases, larger than the coefficients for correspondong criteria for the one-year study group.

9. The standard error of estimate of regression equations was, in general, smaller for the females than males. Prediction error was smallest for the BPE 1 mean criterion and largest for the chemistry/ science option criterion for both groups, but was also large for the English criterion for the current group only.

10. For both the initial and current groups, the grade XII variables which were most frequently assessed predictor weights in regression equations were the social studies, English, and science predictors. The variable which was least frequently assessed predictor weights was the chemistry predictor.

11. The largest single biserial correlation coefficient with the criterion of receiving a BPE degree at UA was 0.757 for the grade XII first-writing social studies predictor. In general, however, the BPE 1 variables predicted most highly as a group to this criterion. There was an apparent sex difference in the prediction of conferring BPE degrees by the communicative-linguistic variables which correlated positively and significantly for the females, but correlated negatively, sometimes significantly, for the males.

Conclusions

On the basis of the findings of this study, the following con-

clusions were drawn:

1. Females' scores on the criterion variables were larger, less variable, and more predictable than males' scores. In addition, certain variables predicted differently for females than males. On the basis of these findings, the use of combined study groups (female-male subgroups in combination) would not be warranted in future similar investigations.

2. Grade XII first-writing scores were more efficient predictors of BPE 1 performance than the corresponding matriculation scores for most variables. Both scores should be considered for admissions and counselling, with the most appropriate applied in given situations.

3. There was no significant decrease of predictive efficiency shown through the use of longitudinal predictions as defined in this study. Predictions could be made with sufficient accuracy for general counselling, but not for individual selection purposes.

4. The criterion of receiving a BPE degree could be predicted with about the same accuracy as first year marks or average. BPE 1 variables, as a group, were the most efficient predictors of this criterion, although there were more efficient single predictors for the female subgroup. Communicative-linguistic variables predicted the criterion positively for females but negatively for males.

5. Most of the conclusions drawn relative to the initial study group were applicable to the current study group. However, there were apparent changes in the meanings of scores for certain variables. For regression equations to retain validity, therefore, they would have to be updated annually.

Applications

Examples of applications of the derived regression equations for

prediction of BPE 1 academic performance at UA are shown in Appendix D.

Based on the findings of the present study, personnel of the Faculty of Physical Education or Student Counselling Services could, within the framework of current admission practices at UA, employ regression equations for guidance of prospective students in course and program selection. Performance level could be estimated, based on the performances of students with similar records who had registered in previous years, and then the student's probability of achieving performance within a given range of this estimate could be indicated. The student, provided with this information of his probability of success in various goals, should then be better equipped to make course or program selections appropriate to his performance potential than would have been possible otherwise.

The pooling of achievement scores from students in sequent years was shown to be an adequate method of gaining an enlarged sample for predicting academic performance where constant definitions of content and emphasis were retained over a period of time. This application of longitudinal prediction would be valuable for estimating potential performances in optional course areas where only a limited number of students register in a specific course in any one term.

Over the period of this study, non-defined changes were apparent in the meanings that could be attributed, for predictive purposes, to scores of certain similarly-defined variables. This emphasized a need to continuously update the data used in developing the prediction battery. Thus, current data should be added as soon as available while earlier data should be deleted when its level of predictive efficiency decreased.

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A P P E N D I X "A"

INTERCORRELATION MATRICES

1956-57 TO 1963-64 STUDY GROUPS

TABLE XXVII

INTERCORRELATION MATRIX*, ALL VARIABLES
FEMALE SUBGROUP, N = 54
1956-57 TO 1963-64

Variables	A	B	C	D	E	F	1	2	3	4	5	6	7	8
A	1000	373	426	623	433	851	039	369	406	288	420	420	383	455
B	373	1000	530	424	509	698	400	591	397	438	512	311	286	562
C	426	530	1000	467	422	706	447	546	303	366	406	101	480	531
D	623	424	467	1000	437	804	217	541	367	587	584	388	387	596
E	433	509	422	437	1000	658	211	656	341	347	418	099	329	473
F	851	698	706	804	658	1000	293	658	487	516	610	403	483	674
1	039	400	447	217	211	293	1000	568	224	365	359	279	442	670
2	369	591	546	541	656	658	568	1000	375	590	593	277	421	768
3	406	397	303	367	341	487	224	375	1000	358	812	326	449	634
4	288	438	366	587	347	516	365	590	358	1000	835	407	429	753
5	420	512	406	584	418	610	359	593	812	835	1000	443	528	842
6	420	311	101	388	099	403	279	277	326	407	443	1000	380	630
7	383	286	480	387	329	483	442	421	449	429	528	380	1000	756
8	455	562	531	596	473	674	670	768	634	753	842	630	756	1000
9	186	472	529	373	379	460	466	556	156	283	264	168	154	411
10	148	272	249	402	251	321	404	328	279	251	317	195	331	428
11	192	219	065	206	170	234	153	159	332	061	229	253	083	239
12	170	327	471	298	364	387	349	422	214	270	289	201	160	379
13	222	334	325	308	326	380	307	354	336	202	317	279	149	379
14	034	334	372	156	200	241	955	514	226	293	315	277	436	630
15	365	492	441	471	614	584	461	908	310	487	490	264	442	689
16	338	170	160	343	082	333	-164	144	645	241	535	308	322	347
17	229	343	222	583	221	417	188	385	241	845	668	376	361	577
18	294	313	254	525	205	431	070	358	582	684	772	414	463	612
19	450	238	122	343	114	398	021	230	279	190	282	732	174	379
20	389	275	475	456	362	506	416	442	486	452	567	391	963	764
21	479	482	481	637	425	660	505	698	565	673	754	627	744	910

* Decimals omitted.

TABLE XXVII (CONTINUED)

Variables	9	10	11	12	13	14	15	16	17	18	19	20	21
A	186	148	192	170	222	034	365	338	229	294	450	389	479
B	472	272	219	327	334	334	492	170	343	313	238	275	482
C	529	249	065	471	325	372	441	160	222	254	122	475	481
D	373	402	206	298	308	156	471	343	583	525	343	456	637
E	379	251	170	364	326	200	614	082	221	205	114	362	425
F	460	321	234	387	380	241	584	333	417	431	398	506	660
1	466	404	153	349	307	955	461	-164	188	070	021	416	505
2	556	328	159	422	354	514	908	144	385	358	230	442	698
3	156	279	332	214	336	226	310	645	241	582	279	486	565
4	283	251	061	270	202	293	487	241	845	684	190	453	673
5	264	317	229	289	317	315	490	535	668	772	282	567	754
6	168	195	253	201	279	277	264	308	376	414	732	391	627
7	154	331	083	160	149	436	442	322	361	463	174	963	744
8	411	428	239	379	379	630	689	347	577	612	379	764	910
9	1000	309	392	559	583	434	447	-064	110	032	099	175	315
10	309	1000	384	411	488	412	331	013	196	148	048	335	371
11	392	384	1000	325	820	149	127	092	024	051	289	130	219
12	559	411	325	1000	807	357	321	-041	158	115	266	235	356
13	583	488	820	807	1000	309	273	033	111	102	341	223	352
14	434	412	149	357	309	1000	486	-165	142	047	055	423	522
15	447	331	127	321	273	486	1000	180	411	410	219	448	726
16	-064	013	092	-041	033	-165	180	1000	313	786	382	341	514
17	110	196	024	158	111	142	411	313	1000	775	188	370	649
18	032	148	051	115	102	047	410	786	775	1000	308	490	735
19	099	048	289	266	341	055	219	382	188	308	1000	241	546
20	175	335	130	235	223	423	448	341	370	490	241	1000	782
21	315	371	219	356	352	522	726	514	649	735	546	782	1000

TABLE XXVIII

INTERCORRELATION MATRIX*, ALL VARIABLES
MALE SUBGROUP, N = 105
1956-57 TO 1963-64

Variables	A	B	C	D	E	F	1	2	3	4	5	6	7	8
A	1000	095	416	458	304	772	068	199	425	350	432	482	388	471
B	095	1000	387	345	245	526	477	243	247	188	241	180	254	365
C	416	387	1000	515	409	752	383	379	234	305	297	294	177	409
D	458	345	515	1000	375	789	238	297	236	355	324	179	194	340
E	304	245	409	375	1000	560	338	405	273	204	273	246	216	392
F	772	526	752	789	560	1000	371	397	433	431	481	440	370	576
1	068	477	383	238	338	371	1000	374	319	209	296	238	223	525
2	199	243	379	297	405	397	374	1000	459	387	479	342	456	679
3	425	247	234	236	273	433	319	459	1000	564	888	592	457	814
4	350	188	305	355	204	431	209	387	564	1000	876	523	367	728
5	432	241	297	324	273	481	296	479	888	876	1000	630	458	870
6	482	180	294	179	246	440	238	342	592	523	630	1000	385	756
7	388	254	177	194	216	370	223	456	457	367	458	385	1000	697
8	471	365	409	340	392	576	525	679	814	728	870	756	697	1000
9	-112	350	315	169	165	190	576	243	119	077	112	109	-065	221
10	038	324	270	065	181	204	466	147	169	108	151	199	283	318
11	053	195	022	037	075	090	269	115	273	190	260	248	198	305
12	-009	420	407	242	230	308	541	315	190	158	189	221	106	323
13	020	386	291	185	196	257	507	274	268	204	260	276	172	375
14	-058	406	321	127	220	221	740	231	106	070	099	052	212	310
15	131	227	285	251	349	310	262	762	274	251	290	194	441	494
16	299	051	009	129	039	210	066	-027	402	175	329	217	136	242
17	251	155	300	331	081	345	024	200	221	671	492	279	214	390
18	406	167	249	313	096	407	153	177	448	589	582	350	258	477
19	361	061	171	014	115	246	-011	222	227	161	223	643	210	359
20	305	172	151	197	199	295	153	245	199	182	205	122	678	376
21	435	321	381	328	311	518	358	497	443	471	509	491	620	683

* Decimals omitted.

TABLE XXVIII (CONTINUED)

Variables	9	10	11	12	13	14	15	16	17	18	19	20	21
A	-112	038	053	-009	020	-058	131	299	251	406	361	305	435
B	350	324	195	420	386	406	227	051	155	167	061	172	321
C	315	270	022	407	291	321	285	009	300	249	171	151	381
D	169	065	037	242	185	127	251	129	331	313	014	197	328
E	165	181	075	230	196	220	349	039	081	096	115	199	311
F	190	204	090	308	257	221	310	210	345	407	246	295	518
1	576	466	269	541	507	740	262	066	024	153	-011	153	358
2	243	147	115	315	274	231	762	-027	200	177	222	245	497
3	119	169	273	190	268	106	274	402	221	448	227	199	443
4	077	108	190	158	204	070	251	175	671	589	161	182	471
5	112	151	260	189	260	099	290	329	492	582	223	205	509
6	109	199	248	221	276	052	194	217	279	350	643	122	491
7	-065	283	198	106	172	212	441	136	214	258	210	678	620
8	221	318	305	323	375	310	494	242	390	477	359	376	683
9	1000	386	355	667	637	508	172	001	036	049	004	-034	188
10	386	1000	464	516	588	440	135	063	-035	081	111	277	298
11	355	464	1000	399	776	109	109	140	029	224	254	015	187
12	667	516	399	1000	888	442	236	093	055	124	134	018	264
13	637	588	776	888	1000	358	217	134	052	198	220	020	275
14	508	440	109	442	358	1000	251	-074	-049	-092	-046	220	371
15	172	135	109	236	217	251	1000	008	123	148	144	300	546
16	001	063	140	093	134	-074	008	1000	130	659	192	207	467
17	036	-035	029	055	052	-049	123	130	1000	712	220	201	521
18	049	081	224	124	198	-092	148	659	712	1000	315	261	641
19	004	111	254	134	220	-046	144	192	220	315	1000	046	515
20	-034	277	015	018	020	220	300	207	201	261	046	1000	680
21	188	298	187	264	275	371	546	467	521	641	515	680	1000

TABLE XXIX

INTERCORRELATION MATRIX*, ALL VARIABLES
TOTAL GROUP, N = 159
1956-57 TO 1963-64

Variables	A	B	C	D	E	F	1	2	3	4	5	6	7	8
A	1000	145	400	511	313	783	001	241	397	254	369	440	306	385
B	145	1000	442	346	387	584	524	400	311	374	393	236	358	499
C	400	442	1000	496	423	735	407	442	261	338	343	249	287	451
D	511	346	496	1000	384	789	206	375	271	396	381	232	230	387
E	313	387	423	384	1000	597	352	510	307	310	357	218	309	457
F	783	584	735	789	597	1000	344	502	451	457	520	427	406	593
1	001	524	407	206	352	344	1000	452	310	374	391	266	399	631
2	241	400	442	375	510	502	452	1000	438	476	527	327	459	704
3	397	311	261	271	307	451	310	438	1000	500	858	532	460	748
4	254	374	338	396	310	457	374	476	500	1000	870	484	474	770
5	369	393	343	381	357	520	391	527	858	870	1000	583	531	873
6	440	236	249	232	218	427	266	327	532	484	583	1000	389	706
7	306	358	287	230	309	406	399	459	460	474	531	389	1000	753
8	385	499	451	387	457	593	631	704	748	770	873	706	753	1000
9	-027	404	388	229	252	288	539	358	141	177	181	134	045	299
10	018	394	282	146	263	252	535	240	224	274	282	219	398	437
11	122	153	026	101	085	140	157	115	272	085	202	229	099	218
12	032	404	434	255	291	339	492	361	208	228	244	225	162	361
13	088	354	303	226	241	303	414	304	288	198	273	276	162	360
14	-065	451	351	124	269	242	835	366	172	267	252	147	383	492
15	209	340	344	327	453	423	333	819	289	345	362	219	436	549
16	323	051	046	201	029	245	-055	019	456	140	342	227	138	216
17	181	323	287	391	197	377	214	303	248	771	590	317	362	521
18	332	268	262	379	168	423	183	265	495	635	654	374	364	541
19	395	090	147	116	096	289	-031	211	231	130	208	652	156	314
20	293	273	272	271	293	379	308	337	301	339	361	213	781	538
21	401	440	425	424	389	576	464	590	485	589	617	527	685	775

*Decimals omitted.

TABLE XXIX(CONTINUED)

Variables	9	10	11	12	13	14	15	16	17	18	19	20	21
A	-027	018	122	032	088	-065	209	323	181	332	395	293	401
B	404	394	153	404	354	451	340	051	323	268	090	273	440
C	388	282	026	434	303	351	344	046	287	262	147	272	425
D	229	146	101	255	226	124	327	201	391	379	116	271	424
E	252	263	085	291	241	269	453	029	197	168	096	293	389
F	288	252	140	339	303	242	423	245	377	423	289	379	576
1	539	535	157	492	414	835	333	-055	214	183	-031	308	464
2	358	240	115	361	303	366	819	019	303	265	211	337	590
3	141	224	272	208	288	172	289	456	248	495	231	301	485
4	177	274	085	228	198	267	345	140	771	635	130	339	589
5	181	282	202	244	273	252	362	342	590	654	208	361	617
6	134	219	229	225	276	147	219	227	317	374	652	213	527
7	045	398	099	162	162	383	436	138	362	364	156	781	685
8	299	437	218	361	360	492	549	216	521	541	314	538	775
9	1000	378	347	641	617	486	274	-034	099	062	024	060	253
10	378	1000	351	496	523	502	214	000	171	160	058	355	381
11	347	351	1000	347	781	078	106	131	-014	128	270	031	165
12	641	496	347	1000	857	426	271	034	130	141	161	114	315
13	617	523	781	857	1000	327	239	095	079	164	256	093	301
14	486	502	078	426	327	1000	352	-140	149	028	-036	353	484
15	274	214	106	271	239	352	1000	063	254	263	162	363	620
16	-034	000	131	034	095	-140	063	1000	147	671	260	218	436
17	099	171	-014	130	079	149	254	147	1000	741	168	324	611
18	062	160	128	141	164	028	263	671	741	1000	293	372	692
19	024	058	270	161	256	-036	162	260	168	293	1000	087	483
20	060	355	031	114	093	353	363	218	324	372	087	1000	733
21	253	381	165	315	301	484	620	436	611	692	483	733	1000

A P P E N D I X "B"

INTERCORRELATION MATRICES

1968-69 STUDY GROUPS

TABLE XXX

INTERCORRELATION MATRIX*, ALL VARIABLES
FEMALE SUBGROUP, 1968-69
N = 25

Variables	A	B	C	D	E	F	1	2	3	4
A	1000	021	344	278	215	603	340	412	236	406
B	021	1000	449	596	357	696	221	184	-019	268
C	344	449	1000	343	610	766	544	722	399	425
D	278	596	343	1000	336	762	266	210	106	305
E	215	357	610	336	1000	597	126	381	340	248
F	603	696	766	762	597	1000	466	551	281	496
1	340	221	544	266	126	466	1000	535	455	382
2	412	184	722	210	381	551	535	1000	444	612
3	236	-019	399	106	340	281	455	444	1000	261
4	406	268	425	305	248	496	382	612	261	1000
5	411	112	492	248	370	466	507	646	755	819
6	226	212	498	272	203	420	478	474	647	311
7	454	193	673	315	333	582	745	826	705	713
8	332	230	525	266	129	460	997	519	426	363
9	190	250	660	246	401	490	447	853	295	465
10	140	026	192	081	386	186	319	276	790	071
11	053	-047	144	-041	389	084	-121	235	108	585
12	148	-106	189	006	486	137	148	330	610	410
13	127	126	226	146	235	228	222	244	373	-021
14	326	117	571	237	437	466	635	712	657	495

*Decimals omitted

TABLE XXX(CONTINUED)

Variables	5	6	7	8	9	10	11	12	13	14
A	411	226	454	332	190	140	053	148	127	326
B	112	212	193	230	250	026	-047	-106	126	117
C	492	498	673	525	659	192	144	189	226	571
D	248	272	315	266	246	081	-041	006	146	237
E	370	203	333	129	401	386	389	486	235	437
F	466	420	582	460	490	186	084	137	228	466
1	507	478	745	997	447	319	-121	148	222	635
2	646	474	826	519	853	276	235	330	244	712
3	755	647	705	426	295	790	108	610	373	657
4	819	311	713	363	465	071	585	410	-021	495
5	1000	585	885	478	478	514	480	671	215	730
6	585	1000	744	456	372	446	-003	305	729	672
7	885	744	1000	725	666	491	260	507	396	863
8	478	456	725	1000	444	340	-123	162	242	642
9	478	372	666	444	1000	230	200	296	194	675
10	514	446	491	340	230	1000	116	769	543	681
11	480	-003	260	-123	200	116	1000	695	101	400
12	671	305	507	162	296	769	695	1000	443	742
13	215	729	396	242	194	543	101	443	1000	650
14	730	672	863	642	675	681	400	742	650	1000

TABLE XXXI

INTERCORRELATION MATRIX*, ALL VARIABLES
MALE SUBGROUP, 1968-69
N = 40

Variables	A	B	C	D	E	F	1	2	3	4
A	1000	540	653	582	447	828	278	359	392	144
B	540	1000	710	588	305	818	288	365	067	-020
C	653	710	1000	762	605	916	234	342	146	-045
D	582	588	762	1000	605	845	354	408	045	-199
E	447	305	605	605	1000	621	447	232	021	-217
F	828	818	916	845	621	1000	352	429	197	-035
1	278	288	234	354	447	352	1000	447	226	-119
2	359	365	342	408	232	429	447	1000	262	119
3	392	067	146	045	021	197	226	262	1000	668
4	144	-020	-045	-199	-217	-035	-119	119	668	1000
5	280	022	052	-090	-105	081	054	200	906	918
6	412	212	243	245	163	335	014	360	580	473
7	489	249	272	269	267	390	445	538	804	618
8	199	113	120	269	389	220	906	345	144	-167
9	307	311	238	301	206	343	425	926	268	149
10	301	-019	090	027	193	140	327	206	785	363
11	042	-188	-110	-194	-137	-127	-022	025	616	865
12	186	-119	004	-071	039	014	183	143	810	721
13	338	161	243	347	305	331	158	323	465	277
14	350	119	238	299	392	317	503	499	616	397

*Decimals omitted

TABLE XXXI(CONTINUED)

Variables	5	6	7	8	9	10	11	12	13	14
A	280	412	489	199	307	310	042	186	338	350
B	022	212	249	113	311	-019	-188	-119	161	119
C	052	243	272	120	238	090	-110	004	243	238
D	-090	245	269	269	301	027	-194	-071	347	299
E	-105	163	267	389	206	193	-137	039	305	392
F	081	335	390	220	343	140	-127	014	331	317
1	054	014	445	906	425	327	-022	183	158	503
2	200	360	538	345	926	206	025	143	323	499
3	906	580	804	144	268	785	616	810	465	616
4	918	473	618	-167	149	363	865	721	277	397
5	1000	573	774	-020	222	614	818	838	404	550
6	573	1000	788	-109	304	403	345	440	871	605
7	774	788	1000	299	509	664	576	727	731	856
8	-020	-109	299	1000	374	294	-001	168	034	470
9	222	304	509	374	1000	167	072	142	229	488
10	614	403	664	294	167	1000	477	821	511	725
11	818	345	576	-001	072	477	1000	885	325	581
12	838	440	727	168	142	821	885	1000	503	768
13	404	871	731	034	229	511	325	503	1000	743
14	550	605	856	470	488	725	581	768	743	1000

TABLE XXXII

INTERCORRELATION MATRIX*, ALL VARIABLES
TOTAL GROUP, 1968-69
N = 65

Variables	A	B	C	D	E	F	1	2	3	4
A	1000	489	600	521	420	800	339	310	373	161
B	489	1000	658	592	358	817	334	212	101	-013
C	600	658	1000	661	619	880	352	424	235	059
D	521	592	661	1000	546	817	349	301	084	-064
E	420	358	619	546	1000	630	376	246	132	-106
F	800	817	880	817	630	1000	419	374	247	041
1	339	334	352	349	376	419	1000	430	324	016
2	310	212	424	301	246	374	430	1000	301	328
3	373	101	235	084	132	247	324	301	1000	501
4	161	-013	059	-064	-106	041	016	328	501	1000
5	295	032	159	002	016	151	185	354	850	877
6	341	184	304	247	168	326	162	399	591	417
7	461	222	393	285	286	418	551	651	761	638
8	273	206	264	288	331	316	940	379	258	010
9	233	228	348	263	248	328	402	892	262	276
10	263	029	132	057	260	167	333	220	786	242
11	-002	-200	-065	-168	-012	-120	-093	127	416	775
12	155	-124	046	-054	153	025	154	217	731	617
13	271	143	236	283	281	290	178	285	433	172
14	333	117	333	279	400	338	541	575	626	422

*Decimals omitted

TABLE XXXII (CONTINUED)

Variables	5	6	7	8	9	10	11	12	13	14
A	295	341	461	273	233	263	-002	155	271	333
B	032	184	222	206	228	029	-200	-124	143	117
C	159	304	393	264	348	132	-065	046	236	333
D	002	247	285	288	263	057	-168	-054	283	279
E	016	168	286	331	248	260	-012	153	281	400
F	151	326	418	316	328	167	-120	025	290	338
1	185	162	551	940	402	333	-093	154	178	541
2	354	399	651	379	892	220	127	217	285	575
3	850	591	761	258	262	786	416	731	433	626
4	877	417	638	-010	276	242	775	617	172	422
5	1000	576	802	132	307	575	706	788	346	603
6	576	1000	768	079	328	414	230	397	824	626
7	802	768	1000	461	570	597	444	642	606	858
8	132	079	461	1000	379	320	-073	154	107	528
9	307	328	570	379	1000	185	130	201	213	557
10	575	414	597	320	185	1000	329	794	521	708
11	706	230	444	-073	130	329	1000	818	244	505
12	788	397	642	154	201	794	818	1000	482	756
13	346	824	606	107	213	521	244	482	1000	710
14	603	626	858	528	557	708	505	756	710	1000

A P P E N D I X "C"

FORMULAE

FORMULAE

1. Testing the Significance of a Difference Between Two Means Using Z Transformations - After Guilford (29:185):

$$Z = \frac{M_1 - M_2}{\sqrt{\sigma^2_{M_1} - \sigma^2_{M_2}}}$$

Where: M_1 = Mean of variable 1

M_2 = Mean of variable 2

$\sigma^2_{M_1}$ = Variance M_1

$\sigma^2_{M_2}$ = Variance M_2

2. Testing the Significance of a Difference Between Two Correlations of a Single Sample Using t Scores - After Blalock (10:311):

$$t = (r_{xy} - r_{zy}) \sqrt{\frac{(N-3)(1+r_{xz})}{2(1-r^2_{xy} - r^2_{xz} - r^2_{zy} + 2r_{xy}r_{xz}r_{zy})}}$$

Where: r = Zero-order correlation coefficients

N = Number of observations

y = Criterion

x = Predictor 1

z = Predictor 2

3. Testing Significance of a Difference Between Two Correlations of Independent Samples Using Z Transformations - After Blalock (10:309, 356):

$$Z = \frac{Z_1 - Z_2}{\sigma_{z_1 - z_2}}$$

Where: Z = Transformations from tables of Z for given values of r

a. Zero-order Correlations:

$$\sigma_{z_1 - z_2} = \sqrt{\frac{1}{N_1 - 3} + \frac{1}{N_2 - 3}}$$

Where: N = Number of observations

b. Multiple Correlations:

$$\sigma_{z_1-z_2} = \sqrt{\frac{1}{N_1-m_1-1} + \frac{1}{N_2-m_2-1}}$$

Where: N = Number of observations

m = Number of variables

4. Biserial Coefficient of Correlation - After Guilford (29:297):

$$r_b = \frac{M_p - M_q}{\sigma_z} \cdot \frac{pq}{y}$$

Where: M_p = Mean of X values for higher group

M_q = Mean of X values for lower group

p = Proportion of cases in higher group

q = Proportion of cases in lower group

y = Ordinate of the normal distribution curve at the point of division between segments containing p and q proportions of the cases

z = standard deviation of the total sample in the continuously measured variable X

5. Standard Error of Estimate of Biserial Correlations - After Guilford (29:297):

$$\sigma_{r_b} = \frac{\frac{\sqrt{pq}}{y} - r_b^2}{\sqrt{N}}$$

Where: N = Number of observations

6. Standard Error of Estimate of Multiple Correlations - After Guilford (29:398):

$$\sigma_{1\cdot23\ldots m} = 1\sqrt{1-R^2_{1\cdot23\ldots m}}$$

Where: R = Multiple correlation coefficient

1 = Standard deviation of criterion

A P P E N D I X "D"

REGRESSION EQUATION APPLICATIONS

REGRESSION EQUATION APPLICATIONS

1. From 1968-69 regression equations, estimate of psychology score for female student who presents the following scores on the grade XII predictors:

English	78
Social Studies	65
Chemistry	80
Biology	60
Mathematics	72

The applicable regression equation would be:

$$.024(\text{Eng}) + .056(\text{So St}) - .006(\text{Chem}) - .005(\text{Sci}) + .019(\text{Math}) - .572(\text{Constant})$$

Substituting achieved scores, the equation becomes:

$$.024(78) + .056(65) - .006(80) - .005(60) + .019(72) - .572 = 5.54$$

Estimate score would be 5.54 with standard error of estimate of 0.81

This student's probability of being awarded a score in psychology between 4.73 and 6.35 is approximately 2 in 3, while her probability of being awarded a score between 3.92 and 7.16 is approximately 19 in 20.

2. From the 1968-69 regression equations, estimate of BPE 1 mean score for male student who presented the following scores on the grade XII predictors:

English	52
Social Studies	55
Chemistry	84
Physics	60
Mathematics	50

The applicable regression equation would be:

$$.029(\text{Eng}) + .031(\text{So St}) + .004(\text{Chem}) - .026(\text{Sci}) + .041(\text{Math}) - .414(\text{Constant})$$

Substituting achieved scores, the equation becomes:

$$.029(52) + .031(55) + .004(84) - .026(60) + .041(50) - .414 = 3.63$$

Estimated score would be 3.63 with standard error of estimate of 1.19

This student's probability of achieving a BPE 1 mean score between 2.44 and 4.82 is approximately 2 in 3, while his probability of achieving a score between 1.25 and 6.01 is approximately 19 in 20.